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PUBLISHERS' NOTE

THIS treatise on Sewing Machine Construction, Adjustment and Repair is issued in the confident belief that it is not only thoroughly practical and reliable, but is so simply worded that even inexperienced readers can understand it. Should anyone, however, encounter unexpected difficulty, he has only to address a question to the Editor of WORK, La Belle Sauvage, London, E.C., and his query will be answered in the columns of that journal.

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SEWING MACHINES:

THEIR CONSTRUCTION, ADJUSTMENT, AND REPAIR.

CHAPTER I.

INTRODUCTION:

THE DEVELOPMENT OF THE SEWING MACHINE.

Over all domestic machinery and appliances the sewing machine stands pre-eminent. In its present perfect form it is the outcome of years of careful study and experiment, and as a piece of mechanism swift, sure, and yet delicate in its action, it is almost without a rival.

The following chapters on sewing machines, their construction, adjustment, and repair, will prove useful to those who have anything at all to do with sewing machines, and they will also be of service to those who, at present knowing nothing of the subject, may be wishful to make themselves acquainted with the principles that govern the action of these interesting machines.

The leading principle of all sewing machines is the stitching together of two or more pieces or parts of fabric by means of thread; and in considering the principles on which sewing machines work, they are naturally divided into classes by the manner in which the cotton or thread is manipulated to obtain the desired result. Sewing machines form two classes—(*a*) those producing a chain-stitch, and (*b*) those producing a lock-stitch.

In a chain-stitch machine there is only one thread, which, by means of a needle and special mechanism, is twisted into the material in such a manner as to give on one side the impression of

a chain. Fig. 1 shows the formation of the stitch through the material, Fig. 2 being a top view of the stitch, and Fig. 3 a bottom view.

In the lock-stitch machine there are two threads, the top wound on a bobbin and running

Fig. 1.—Section showing Chain-stitch.

through the needle, and the bottom contained in a shuttle, which runs through loops formed by the top thread, or in a spool round which the top thread is directed by the hook-holder carrying the spool. These two threads lock each other in the centre of the material, hence the name "lock-stitch." The formation of stitches on the lock principle is illustrated in Figs. 4 and 5. Fig. 4

Fig. 2.—Top View of Chain-stitch.

shows the formation through the material, and Fig. 5 the appearance of the stitch on the top and under side, which are, when properly adjusted, both alike.

Of lock-stitch machines there has been an innumerable variety invented on different principles. Some have reciprocating shuttles carrying the bottom thread, some have rotary shuttles,

Fig. 3.—Underneath View of Chain-stitch.

and some have stationary shuttles or spools; but owing to the recent lapse of certain master patents there is a general resemblance between most types of modern lock-stitch machines.

The first practicable sewing machine was in-

vented (on paper) in 1790 by Thomas Saint, a cabinet maker, of London, who compiled a specification and set of drawings; the machine was constructed several years ago from the inventor's designs. Many of its features are present in the modern machine. It is

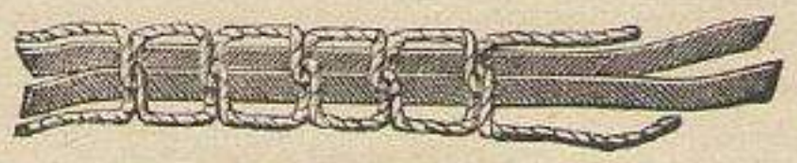


Fig. 4.—Section showing Lock-stitch.

of the chain-stitch, single-thread type, and consists of a table with an overhanging arm—which feature, it will be observed, is retained in modern sewing machines—and a horizontal shaft. The latter, through the medium of a ratchet wheel, reciprocates a vertical needle bar. The machine appears to have been intended chiefly for leather work, and was provided with an awl working vertically, which pierced a hole for the thread. A spindle and projection laid the thread over this hole, and a descending forked needle pressed a loop thread through it. The loop was caught on the under side by a reciprocating hook, a feed moved the work forward the extent of one stitch, and a second loop was formed by the same motions as the first. It descended, however, within the first, which was thrown off by the hook as it caught the second, and being thus secured and tightened up, an ordinary tambour or chain-stitch was formed.

The French claim that the inventor of the sewing

Fig. 5.—Top and Underneath View of Lock-stitch.

machine is Thimmonier, who patented in France, in 1830, a machine having a thread-carrier beneath the work; a crochet needle descended through the work and caught up a loop which enchained the previous loop.

Elias Howe's machine, made in Boston, U.S.A., in 1845 and patented in 1846, was bringing him by 1863 an enormous income. It is of the lock-stitch type, and the work to be sewn, instead of lying horizontally, hangs vertically, being fixed on pins embedded in the edge of a thin metal baster plate, which can be bent to the curve of the seam to be sewed. The baster plate is drawn through the machine by the teeth of a pinion, the motion being intermittent, and thus carries the cloth forward in front of the needle. The needle is curved, and the eye is placed near its point. The thread passes from a spool above, and down through the eye. The needle is attached to a pendant vibrating lever, and when the point has passed through the cloth a certain distance and is just returning, a shuttle, containing a bobbin of thread and sliding in a shuttle race, passes through the loop that extends from the cloth to the eye of the needle, and leaves the shuttle thread in the loop. The needle then rises, and both threads are pulled taut, with the needle thread in the front of the cloth, and the shuttle thread behind, but both threads cross in each hole made by the needle. Although the needle swings in a vertical plane, it passes through the cloth horizontally. The shuttle travels to and fro horizontally with the point, or nose, downward, being driven from end to end of the race by two strikers, which are operated by arms and cams secured to the main shaft.

The above machine was the forerunner of others produced by the same inventor, who, however, was soon followed by Singer, whose machines, being much lighter to work and also simpler in construction, soon gained favour, and are still copied, with slight modifications and improvements, by most of the German firms.

The chief defect in the early sewing machines above mentioned were friction (and consequent

wear and tear), great noise, and slow movement, especially in the Howe machine, and liability to breakage in the gear wheels in the Singer.

These machines were followed by revolving hook machines made by Wheeler, and by Newton and Wilson, who afterwards amalgamated and formed the Wheeler and Wilson Company of the present day. The revolving hook machines possessed great advantages over the original machines, inasmuch as there was less friction with them, although in some respects they possessed disadvantages. They had, instead of a shuttle, a hook, which revolved around a spool which remained stationary. A machine manufactured by Grover and Baker was also introduced, but found little favour, as it used a large amount of cotton; it had a straight needle above and a curved needle underneath, and produced a lock-stitch which had the appearance on the under surface of the work of a double-chain stitch. Later, the vibrating shuttle sewing machines were introduced, the shuttles of which vibrated to and fro in the arc of a circle. They were a great improvement on the earlier styles; the vibrating movement, which is simple, strong, speedy, and almost silent, is still to be found in many of the present-day machines. Lastly, the oscillating shuttle lock-stitch machine has been introduced by the Singer Manufacturing Company, and has overcome most of the difficulties which were met with in the older machines. The shuttle moves in a vertical race in an arc of about 201°. Machines of this type and of the newest design will work, if well oiled, up to fifty stitches per second, with very little friction.

So successful has the single-needle machine become that machines are now in use with two, three, four, and even twelve needles, actually making twelve rows of stitching at one operation, as well as inserting other things used in the

making up of the article, by means of attachments and devices.

The chain-stitch machine is used for stitching light materials, and is capable of greater speed than the lock-stitch machine. It is not generally used where great strength is needed, except sometimes in the manufacture of boots and shoes, but is employed at high speed on light goods such as hemming or stitching where the ends are turned in or sewn under; it can also be used with advantage for ornamenting table covers, antimacassars, etc., the material being worked wrong-side upper-

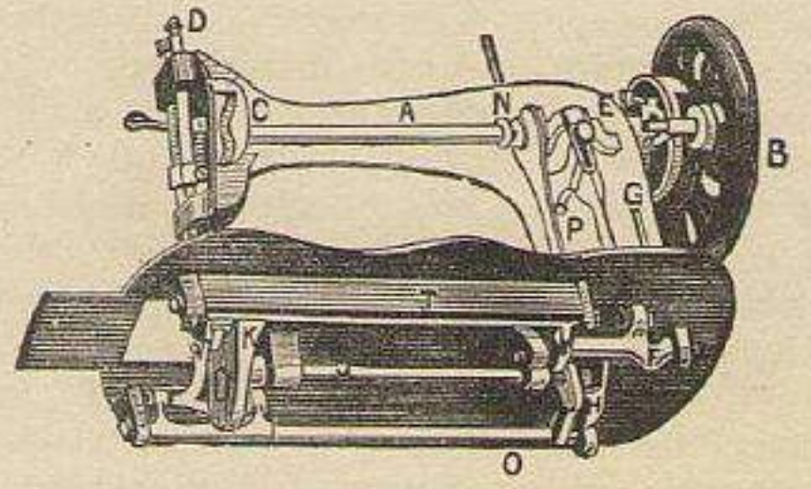


Fig. 6.—Singer's Old Style Oscillating Shuttle Machine.

most. The capacity for a single-needle chain-stitch machine is from 3,000 to 4,000 stitches a minute. This class of machine is constructed so as to use from one to twelve needles at one time, and by an ingenious invention a chain-stitch machine can also fold the material into tucks, thus in one operation making and stitching from one to twelve rows of tucks, as may be required.

For heavy work, where strength and durability are required, the lock-stitch machine has no equal. As has been shown, this has been made in various forms. First it was on the principle of a boat-shape shuttle, its movement being from fore to aft of the needle, and from this various styles were

evolved, the principle remaining the same. At the beginning there was a lack of speed, for, owing to the construction of the cams and the action of the shuttle, machines of this type could not be worked at a high speed. Hence the invention of the oscillating shuttle, vibrating shuttle and rotary hook machines.

The oscillating shuttle was placed in a race or ring, and, by means of cranks, levers, and links, the motion of the machine was quite altered, and higher speed made possible. It was found that a reciprocating motion produced undue friction, so the rotary hook was improved, and with these

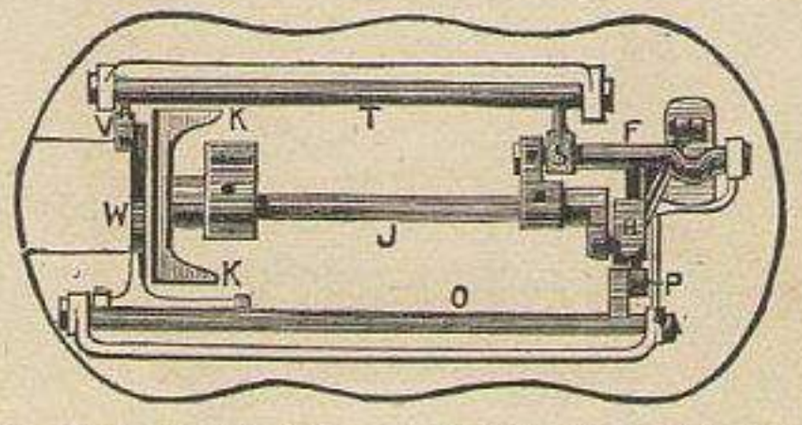


Fig. 7.—Underneath View of Singer Old Style Machine.

two styles of machines on the market the whole sewing machine trade was revolutionised. Owing to the relative position of the shuttle to the needle it was evident that two needles could be worked at one time with success, and this idea was developed, until to-day several needles and shuttles are used at one time.

The early form of the Singer oscillating shuttle machine is illustrated by Fig. 6, a view of it from underneath being given by Fig. 7. The shuttle has an oscillating movement about a centre. In the whole of this machine there is only one parallel sliding movement—that is, the needle-bar. The shuttle moves in the arc of 201° of a circle. The shaft A runs through the arm, and carries on

one end the pulley and balance wheel B, and on the other the take-up cam C, to the face of which a link is attached for transmitting the motion to the needle-bar D. At the end of the shaft nearest the wheel is the crank E, which gives the rocking motion to the shaft F, under the machine, by means of the connecting-rod G. From this rocking-shaft F projects a bearing-arm or sleeve H, which engages with a roller on the crank at the end of the oscillating shaft J. This imparts movement to the shuttle, which is arranged in its

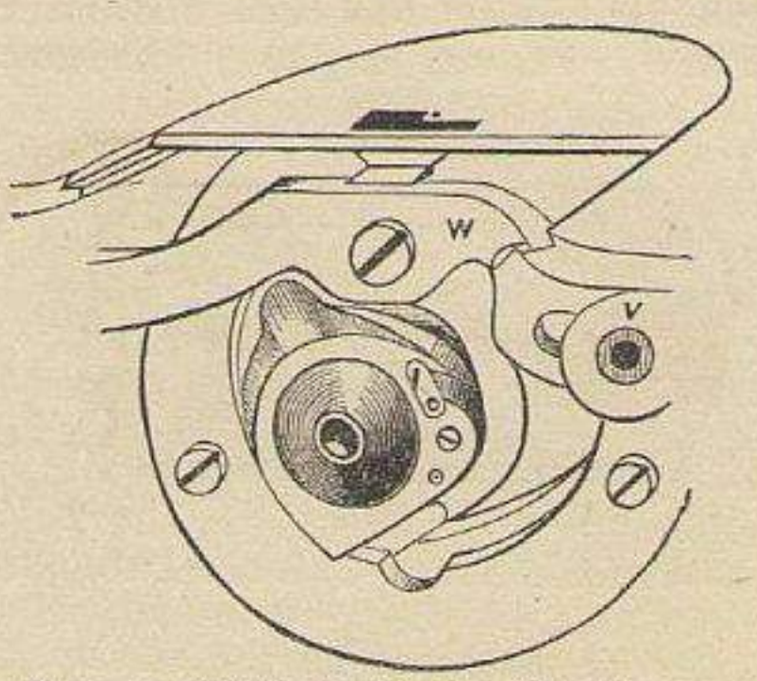


Fig. 8.—Singer's Old Style Shuttle, Shuttle-race, etc.

carrier, at the end of shaft J, and runs in a circular shuttle-race K. The shuttle-race, shuttle, feed levers, etc., are shown by Fig. 8, a bobbin by Fig. 9, and a shuttle with threaded bobbin in place by Fig. 10. The tension of the top thread is obtained by drawing the thread between two steel discs upon which presses an adjustable spring; though in some machines the thread is coiled around a pulley instead of passing between discs. There also is a small side-spring to ensure control of the slack thread between the tension and the needle eye. The tension on the bot-

tom thread is obtained by the pressure of a spring placed between the two hinged parts of the shuttle, through and under which the thread from the reel passes; it is adjusted by the small screw M (Fig. 10).

The take-up is operated by means of the cam C, and is positive; that is to say, both the upward and downward movements are operated by the mechanism, and do not depend on the action of any spring.

The feed is divided into four motions—the ascending and descending motion, and the advancing and receding motion. The mechanism

Fig. 9.—Threaded Bobbin.

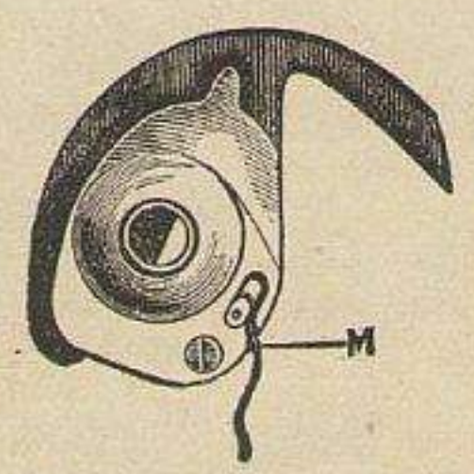


Fig. 10.—Bobbin in Old Style Shuttle.

producing the upward movement of the feed is the simplest. The rocking-shaft F (Fig. 7) has on its left-hand end a cam S which operates a sleeve surrounding it and fixed to the shaft T. At the left-hand end of shaft T is another arm and roller movable in the feed-bar W, and to which it imparts its upward and downward movement. This movement is not adjustable. The onward movement requires to be adjustable, and is worked in the following way. An eccentric cam N on the rotating shaft A (Fig. 6) operates a connecting link P attached at the other end to the rocking-shaft O, and pivoted on a movable centre attached to the adjusting screw shown on the arm of the

machine (Fig. 6). This alteration of the pivot by means of the stitch-regulating screw varies the rock of the shaft O, and determines the stroke of the feed and length of the stitches. The rocking-shaft O has on its left-hand end two projecting ears, between which the forked end of the feed-bar W is pivoted. This machine can be adjusted to make stitches of a size from six to the inch, to any number consistent with the size of the needle and thread employed.

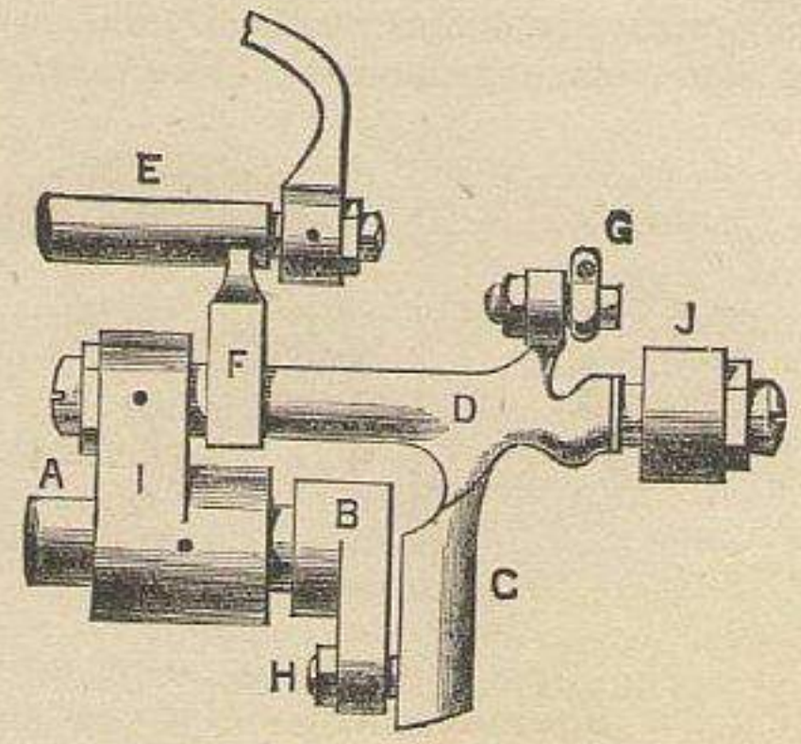


Fig. 11.—Singer Rocking-shaft.

The mechanism operating the rocking-shaft of the shuttle-carrier is shown in greater detail by Fig. 11. It might appear that if the connecting link G were attached direct to the crank B, the intervening mechanism could be dispensed with, and the shuttle-shaft thus receive its motion direct from the crank on the shaft A (Fig. 6). But one of the essential features of this machine is that the shuttle shall make a stroke of more than half a circle. In order to accomplish this, an intermediate shaft D (Fig. 11) is required, and this

receives its movement—a rock of nearly half a circle—from the connecting-rod G. The centres of the two rocking-shafts D and A (Fig. 11) are nearly an inch apart. In the diagram (Fig. 12) let the line A B represent the sleeve C (Fig. 11), pivoted at A, and the line C D represent the crank B (Fig. 11), pivoted at C, and having at D a roller which can slide only up and down the line A B. Then the thick lines will represent the position of the two arms in the middle of the stroke, and the dotted lines at each side the positions respectively at the beginning and end of the stroke. It will be seen that while the line A B has only travelled

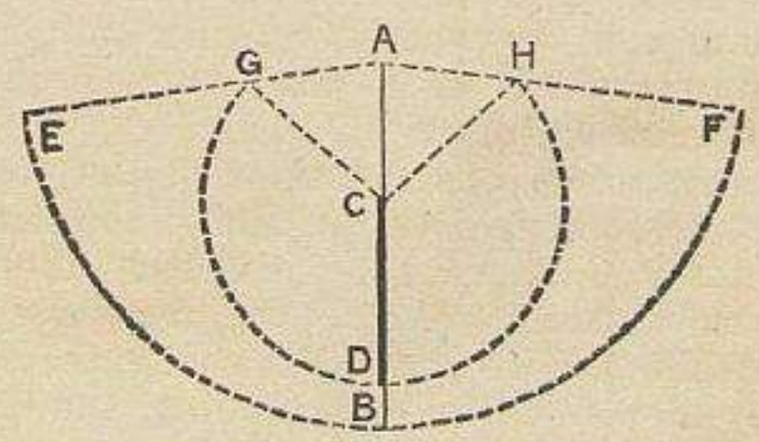


Fig. 12.—Rocking-shaft Motion.

in the arc of a circle from F to E, covering about 90°, the line C D has travelled from H to G through an arc of about 200° (actually 201°), or more than half a circle. This will explain how the principle is applied.

The above applies to the Singer oscillating shuttle machine in use more than a decade ago, and whilst it shows the principle of the modern machines, it does not represent the actual details now adopted. The details of the modern machine are illustrated later, but the description above given will be found very useful, as there are thousands of machines of this type in regular employment.

When increasing the speed of the machines, if

they were worked too quickly, take-up cams were noticed to wear owing to the sharp action necessary to give movement to the lever; then was brought into use a link take-up, doing away with the cam. With the rotary hook machine it was discovered that, owing to a "variable movement" (see pp. 20, 28, and 60)—necessary to reduce friction and tension on the thread—the speed of the machine was lessened. After much experimenting the vertical hook was invented, by means of which a high speed is possible, and, the movement being purely rotary, wear and tear is reduced to a minimum, and the construction of the hook is such as to allow for an extra large bobbin; also two rows of stitching can be worked satisfactorily in one operation, just as close as may be desired, this being a special feature.

As to the variety of stitch now possible, besides the strong stitching of seams and plain stitching of facings, etc., there may be seen fancy and ornamental stitching. As to the last, a row of fancy stitching can be worked as easily and almost as rapidly as a row of plain stitching, the designs being in some cases most exquisite.

Again, the buttonhole machine in itself is a marvel of skill, material simply being placed in the machine, and then thrown out with a beautifully worked, punched, and barred-off buttonhole.

Sewing machines are manufactured for well-nigh every class of goods that can be stitched at all, from a piece of finest Japanese silk to the heaviest military trace.

CHAPTER II.

TYPES OF SEWING MACHINES.

Sewing machines, as already pointed out, are divisible into two classes, chain-stitch and lock-stitch.

Chain-stitch machines may be dealt with at once and the subject left. The name is taken from the formation of a loop or chain on the under side of the material. The needle-bar descends with the needle carrying the cotton to its lowest point, then rises slightly (from $\frac{3}{32}$ in. to $\frac{1}{8}$ in.), forming the cotton into a loop, which at this point is entered by the looper. The last, continuing its movement, spreads open the loop, giving it a twist. By this time the needle descends again through the loop, which is released from the looper when the needle has entered sufficiently. The loop then passes up the needle to the under side of the material, and is pulled tight by the tension. Then another loop is formed by the needle, and the looper enters that before releasing the former one. Thus the looper is never clear of the cotton when working correctly, and to remove the material the cotton must be broken off the looper by a sharp pull. The movements of chain-stitch machines are similar generally to the rotary hook lock-stitch machine (see p. 23), but the hook having picked up the needle cotton does not drop or allow it to slip off until it has picked the second needle loop. It is very essential in chain-stitch machines to have the right make of needles, as poor needles cause endless trouble. The short groove of the needle is nearest the hook, and the hook should pass as near the needle as possible without touching. See that the hook is perfectly smooth, and do not alter its shape in the slightest.

A lock-stitch, when properly made, has the same appearance on both sides, whilst a chain-stitch shows a loop or chain on the under side. The lock-stitch derives its name from the fact that two threads are used, an upper and lower one, and at each stitch both threads are locked. In most lock-stitch sewing machines the upper thread is carried by a needle, whilst the under thread is carried by a shuttle, but the relative action of the needle and the shuttle varies considerably.

In a lock-stitch machine the following is roughly the sequence of operations: The needle carrying the upper thread (1) descends through a hole in what is called a needle-plate, or throat-plate, to its lowest point of travel; then (2) it rises slightly, forming the cotton or thread into a loop; at this point the shuttle (3) enters the loop, and (4) passes through it, and the needle (5) rises to its highest point, and the take-up lever pulls up all slack thread. By means of this and the tension put upon the cotton the under thread is drawn and locked into the goods.

The above operations are carried out in the following manner: The needle descends to the bottom of its stroke, and, simultaneously, the shuttle slides, vibrates, or oscillates as far as the end of its backward movement. Continuing the movement of the balance wheel, the needle begins to rise, and the shuttle immediately after begins to move forward. As the needle rises, the material through which it is passing holds the needle cotton enough to cause it to loop out behind the eye of the needle under the needle-plate. The shuttle, still moving forward, enters this loop and passes through it, the necessary amount of slack cotton being supplied either by the "time" of the needle-bar or by the check or take-up lever, according to the style of the machine. By the "time" of the needle-bar is meant the movement which is caused by a cam on the bar, causing

it to descend the second time after it has risen sufficiently to throw out its loop and to allow the shuttle point to enter it. This descent throws off enough slack cotton to pass over the body of the shuttle without causing any strain on the cotton, and as soon as the shuttle has passed through the loop the needle-bar rises to its highest point and draws up the cotton into the material being sewn and the bottom or shuttle cotton with it,

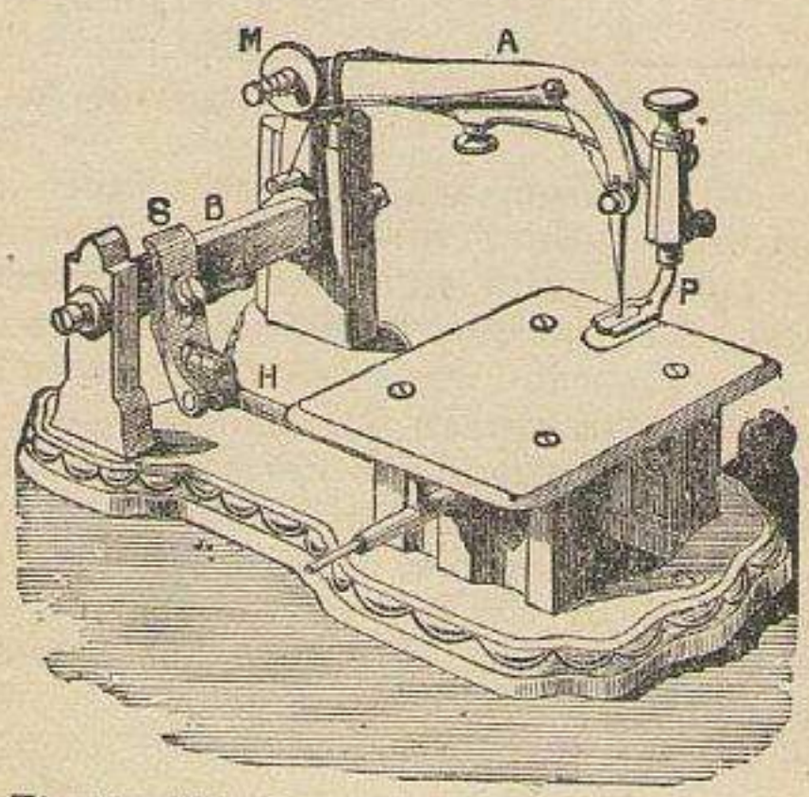


Fig. 13.—Wheeler and Wilson Old Machine.

completing its stitch. Under the material and under the needle-plate is a feed dog which rises just before the needle has reached its highest point, and, moving back, carries the material with it the required distance and sinks below the needle-plate before the needle enters the work again.

If the lock-stitch machine is a rotary hook machine, the hook, instead of sliding or oscillating backwards, continues to revolve, and is so arranged that when the needle is at the lowest

part of its movement, the point of the hook is a little behind it, generally about $\frac{3}{16}$ in., a little more or less according to the style of the machine.

The curved needle, revolving hook machines, the chief representative of which has been the

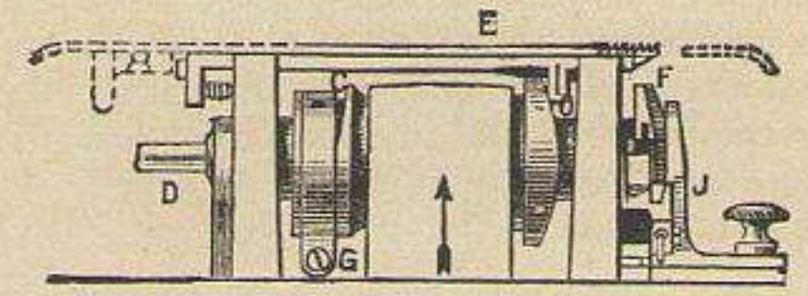


Fig. 14.—Mechanism of Wheeler and Wilson Old Machine.

Wheeler and Wilson, are used extensively in the manufacture of shirts, collars, cuffs, and white goods generally. Having but few parts, this type of machine runs smoothly, and it is easy and silent in action. The chief reason for its introduction was to obviate the wear and tear of shuttles by the substitution of a hook revolving round the spool. As will be seen from a general view of it given by Fig. 13, the rocking-arm A is pivoted by a cross-bar B; by the side of the rocking-arm is an arm with a presser foot P to hold the fabric

Fig. 15.

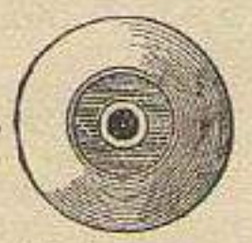


Fig. 16.

Figs. 15 and 16.—Wheeler and Wilson Bobbin.

firmly; the front consists of a square table under which (see Fig. 14) are the pulley, C; shaft, D; feed arrangement, E; and hook, F. The pivoted cross-bar carrying the rocking-arm receives its motion from a cam G on shaft D, by means of a

connecting-rod H (Fig. 13). Unlike most machines, the work travels from left to right instead of away from the operator, and the needle, instead of being straight, is curved. The formation of the stitch in this machine is peculiar. It is a combination of the hook principle of the Wilcox and Gibbs machine and the under thread shuttle arrangement of other forms of machine. The under cotton is wound on a spool or metal bobbin of the form shown in Figs. 15 and 16, by fixing the bobbin temporarily on the projecting end of

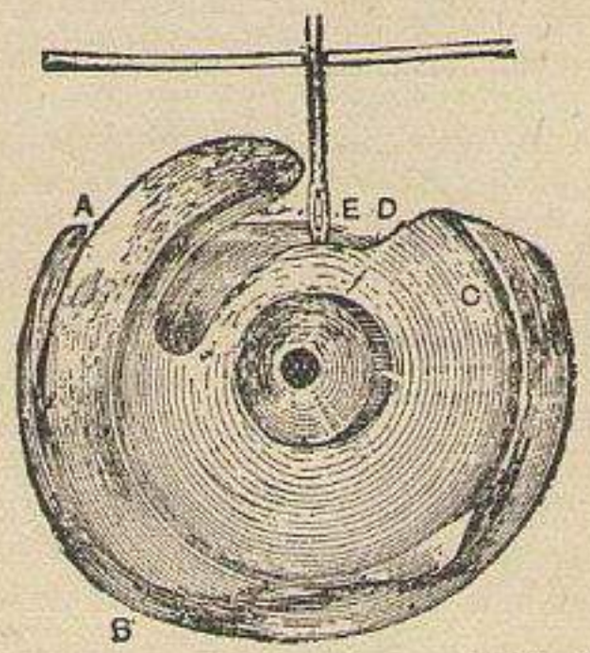


Fig. 17.—Revolving Hook and Needle.

the shaft or spindle, and running the machine so as to wind the cotton on or in the spool. This bobbin is placed, when charged with cotton, in the hollow face of the rotating hook (Figs. 17 to 19), and kept loosely in place by the ring slide shown at J (Fig. 14). This ring is provided with an adjustable stop, which causes it, when pushed right up, to hold the bobbin loosely in its place, the object of this being to allow the loops of the top thread to pass completely round it.

A hook for a curved needle machine is represented by Fig. 17. The groove A is about $\frac{7}{8}$ in.

long, begins about $\frac{5}{8}$ in. from the extreme point, is about $\frac{1}{8}$ in. wide, and $\frac{1}{16}$ in. deep, gradually tapering and narrowing till it reaches the circumference; at a short distance (B) beyond this the hook is chamfered. C represents a recess which admits the metal spool holding the under thread. A bridge D from the throat to the heel of the hook acts as a guard and prevents the needle springing on to the hook point. E is a washer or back wall of the hook, and reference to it will be made later.

The stitch differs from the usual lock-stitch,

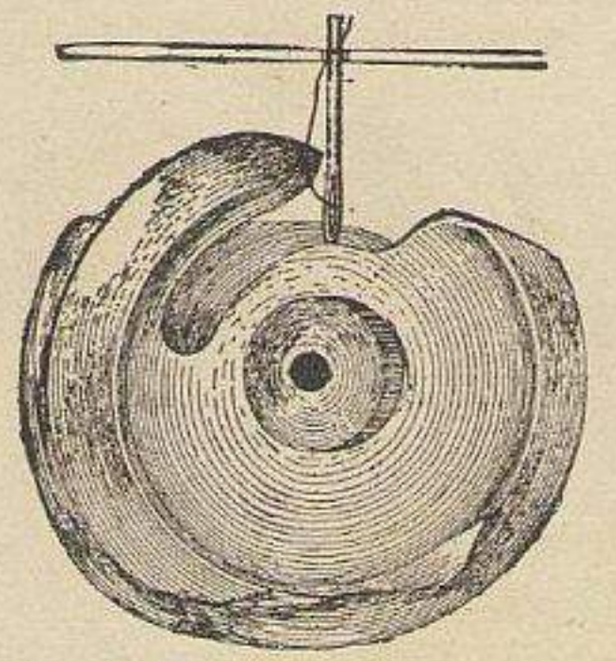


Fig. 18.—Revolving Hook when Forming Stitch.

and a knowledge of its formation will greatly aid the worker in adjusting this class of machine. The needle carrying the upper thread descends to its lowest point of travel, then rises slightly, forming the thread into a loop, into which the point of the rotating hook enters (see Fig. 18). As the hook revolves, it makes the loop larger by drawing more slack; continuing its movement, the thread is drawn into groove A (Fig. 17) until it reaches the chamfered part B. At this point one line of the thread slips off and falls over the outer side of the bobbin or spool (the other line of the

thread lies at the rear). The loop thus passing round the bobbin interlocks the under thread and forms a lock-stitch. Now it can easily be seen that when the hook has made rather more than half a revolution the loop would slip off the hook and become uncontrollable, hence it is necessary to hold it until the hook has completed its action. For this purpose a small brush A (Fig. 19) is fixed so as to press slightly against the hook and thus retain the thread until the hook

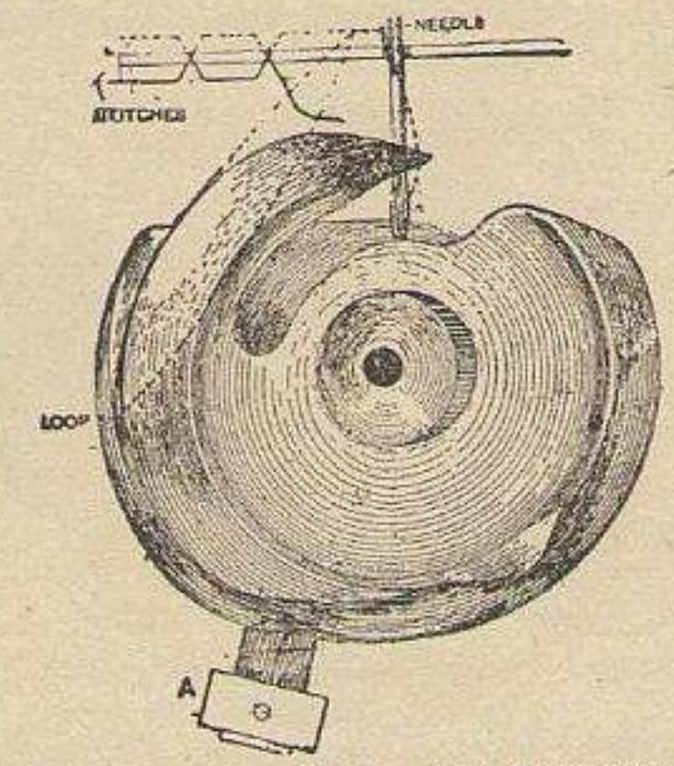


Fig. 19.—Revolving Hook when Forming Stitch.

point has entered the loop made for the succeeding stitch, at which time the thread is released owing to the bevelled edge of the hook passing the brush and making an exit for it. At this point (see Fig. 19) there remains a long loop to be drawn into the fabric. In most other machines a take-up lever is attached for this purpose, but here the loop is drawn into the goods by the action of the hook. After the hook has entered the loop formed by the rising of the needle, it enlarges it, and in so doing draws up the slack

of the previous stitch and locks it (see Fig. 19). The dotted lines indicate the upper thread, the full lines the lower or bobbin thread. Fig. 19 represents the locking of the stitches in the centre of the material, and the hook just entering the loop is about to draw the previous stitch tight into the fabric.

Evidently in the revolving hook machine each stitch is formed partly from the former stitch, but with the addition of some thread drawn from the upper reel. On this upper reel there must be a certain amount of tension or the hook in its action will draw thread from the reel instead of drawing

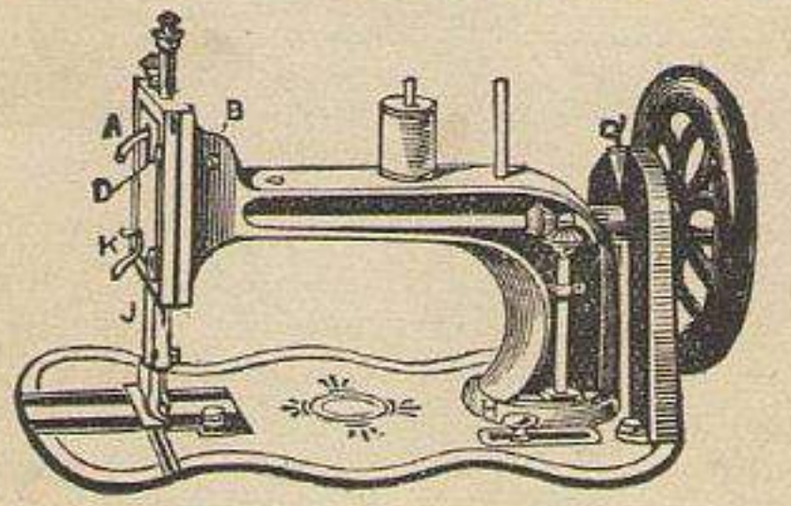


Fig. 20.—Singer Reciprocating Shuttle Machine.

up the previous loop. Therefore, a tension pulley M (Fig. 13, p. 23) is operated by a spring, and great care should be exercised in adjusting the tension and the pressure of the brush against the hook.

In the new styles of revolving hook machines the brush is abolished, and the hook has what is called a differential motion—that is to say, the hook moves faster at one part of its revolution than it does during the remainder. These hooks are fixed by two set-screws, and can be shifted if out of time.

Two popular forms of Singer sewing machine with a reciprocating—not oscillating—shuttle are known as the Family and Medium machines,

and a brief account of this type may be of advantage. The defect in its design, overcome by the invention of the oscillating shuttle machine, is the enormous strain thrown on the mechanism at each end of the shuttle's stroke.

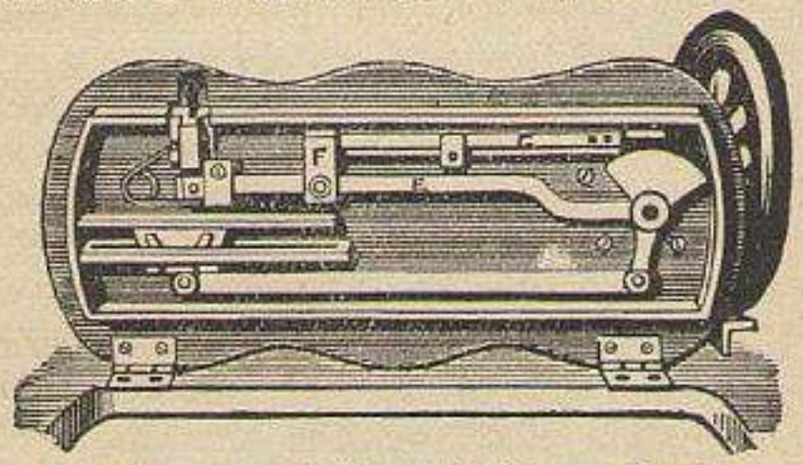


Fig. 21.—Underneath View of Singer Reciprocating Shuttle Machine.

A general view of the reciprocating shuttle machine is shown by Fig. 20, and an underneath view by Fig. 21. In this machine there are two shafts or spindles to convert the rotary motion from the strap. One spindle runs horizontally in the interior of the arm, at the top of the machine, carrying at one end the balance wheel

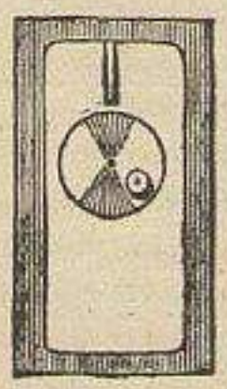


Fig. 22.—Front View of Arm with Face Removed.

with a groove for the strap, and at the other end the disc and roller (as shown in Fig. 22) for imparting the upward and downward motion to the needle-bar. The other stands vertically, having at its top end a bevel gear wheel, which gears

into a similar bevel wheel on the horizontal shaft, from which it receives its motion. At the lower end it carries the cam for operating the feed, and the balanced crank giving the reciprocating movement to the shuttle-carrier by means of a pitman, or connecting-rod. This arrangement is shown by Fig. 21.

The shuttle movement is in a line at right angles to the direction of the sewing, while in other reciprocating shuttle machines the shuttle moves in a line parallel to the line of sewing, or in the arc of a circle, of which the line of sewing forms the cut side. There are two threads, one running from the bobbin to the needle, and one contained in the shuttle; the shuttle is carried through the loop of the top thread, so that the action is really this: The needle descends, and on again rising gives a momentary pause when the eye is just below the line of the shuttle point, and forms in the thread a loop; the shuttle advances, and the point runs through the loop caused by the momentary pause of the needle; the action is continued until the shuttle has passed completely through the loop. But this passing of the shuttle through the loop takes out from the needle more thread than was required for the stitch being made; this excess of thread is gathered up by the take-up.

The take-up is shown at A (Fig. 20); it is really a lever pivoted on the screw B, and passing through a slot in the needle-bar out into the front of the machine, where it is provided with an eye through which the thread passes after having left the tension. A spring placed inside the head of the machine presses the take-up lever against the top of the slot in the needle-bar through which it passes, so that when the needle-bar descends it takes with it the lever and gives the shuttle the thread it requires, while on its ascent it is allowed to draw up by the action of the spring what

thread is not required for the stitch, repeating the movement at each stitch.

The motion of needle and shuttle should exactly correspond; and the relation of these two movements to one another entirely depends on the right adjustment of the two bevel wheels connecting the horizontal and vertical shafts. The operation of adjusting these movements is called timing, and the whole art of timing is to have the bevel wheels in such a position on their

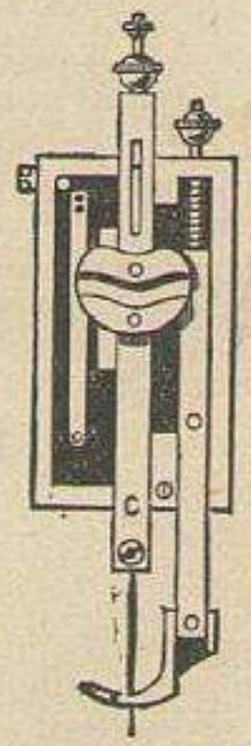


Fig 23.—Reciprocating Shuttle Machine with Face-plate Removed.

shafts that, when the needle pauses in its upward movement to make the loop, the shuttle shall be just ready to pass through the loop thus made. The first attempt to time a machine is fairly certain to be a failure.

The tension of the top thread in this machine is obtained in the following way: As shown in Fig. 20, on the face of the machine is a small appliance consisting of two steel discs drawn together by the action of a spring C (Fig. 23). A screw D (Fig. 20), with a milled head, passes

through the face of the machine, and the desired tension is obtained by screwing this up, and thus pressing it against the spring, which, in turn, draws the two discs closer together, nipping the thread which runs round between them on its way to the take-up.

Fig. 24, showing the shuttle and bobbin, will give some idea of how the tension on the bottom thread is obtained. The spool on which the thread is wound is placed in the shuttle, with the thread coming from the under left-hand side when the point is toward the operator; the thread then passes through the bottom long slot on the left-hand side and back through the top slot, over the reel, and in and out of the holes from heel to

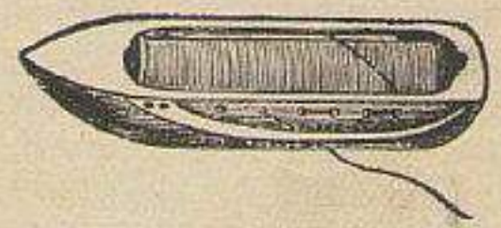


Fig. 24.—Shuttle with Threaded Bobbin.

point, and out of the last hole under the spring, as shown. The number of holes through which the thread passes constitutes the tension, and, by increasing or diminishing them, the tension can be increased and diminished in proportion.

The arrangement of the feed and stitch regulator is shown in Fig. 21. The vertical shaft carries at one end a cam—just hidden in the illustration by the crank—and this gives a rocking and backward and forward motion to the feed-bar E which is pivoted for its rocking motion at F. By a series of inclined planes this combined motion of the feed-bar is communicated to the feed itself, the rocking motion of the feed-bar or lever giving to the feed its onward movement, and the backward and forward movement giving the upward movement to the feed. Any regula-

tion of the stitch which is caused by the onward movement of the feed will have to be made by regulating the rocking movement of the feed lever which produces that onward movement; so that shifting the fulcrum or pivot on which the lever moves will have this effect. This is accomplished by having the pivot attached to a slide G (Fig. 21) so that it can be moved backward and forward and clamped by a screw H (Fig. 20) passing from it through the base of the machine. Thus by unscrewing this screw and moving it along the slot the stitch can be regulated in length.

In all sewing machines the presser foot accomplishes two purposes; first, it presses the material down to the feed to ensure it being carried along properly; and secondly, it prevents the needle bringing the work with it on its ascent. This presser foot is shown at J in Fig. 20. It is pressed down by a spring, the pressure of which can be regulated by a screw, and may be lifted up by a lever working on the principle of an eccentric, and shown by K (Fig. 20). It has to be lifted when removing the work, etc.

Winselmann's vibrating shuttle sewing machine working precisely on the modern Singer principle, and fitted to work by hand, is shown by Fig. 25. It is attached to a polished wood base A, and is operated by turning the handle B to the rear. Machines are also constructed to work by treadle, and are made in a variety of styles. It runs very easily and rapidly, and may be used for stitching all kinds of light fabrics, ranging from Japanese silk to Melton cloth. Fig. 26 shows the working parts, with only one cotton holder, the action of the mechanism being very simple. The crank A in the arm shaft produces a swerving motion in the vertical connection lever B; this lever is connected horizontally to the shuttle carrier bell crank C, thus producing the vibrating movement of the shuttle. At the lower end of lever B is an

eccentric stud, the turning of which alters the time of the shuttle movement. The feed or stitch movement is obtained by the cam D working in the fork connection E, the length of stitch being regulated by turning the thumbscrew F to the right to lengthen it and to the left to shorten it.

The feed points may be raised or lowered by loosening the feed set-screw G, which is located just below the needle-plate. Care should be taken

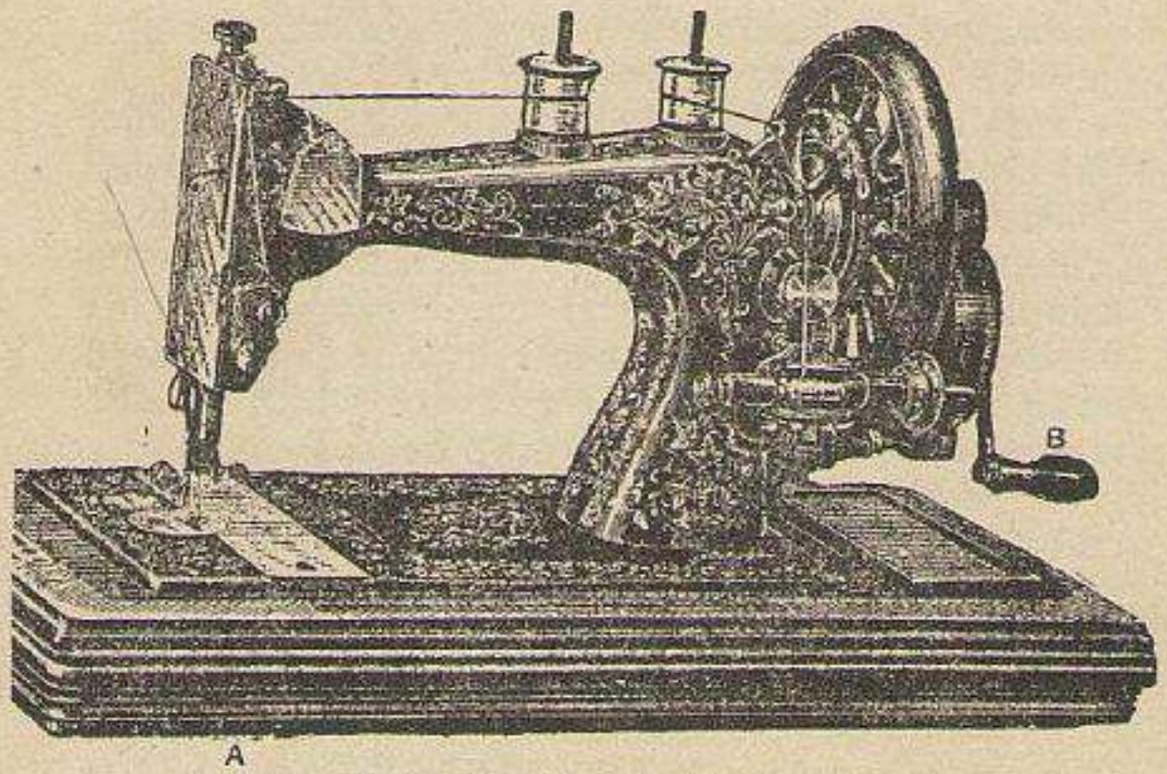


Fig. 25.—Vibrating Shuttle Sewing Machine.

not to set the feed points too high. If the feed movement is imperfect, attend first to the height of the feed. When the feed is too low the material will not be fed along very well, and may stand still at a seam. If the teeth are worn smooth, the feed may be softened by heating to a blood red and sharpening with a file when cold. For fine silk work have the feed set rather low, and do not have the teeth too sharp.

The needle-bar movement is produced by the cam (Fig. 27), the action of which is similar to

that of the "Family" and "Medium" type of machine (see p. 31). By means of a roller and stud attached to the take-up cam H (Fig. 26), which works in the groove of a cam (Fig. 27), the needle-bar is made to descend and then to rise slightly to form the loop; it remains stationary until the shuttle has well entered the loop thus formed, then it descends still further in order to give off sufficient slack cotton for the swell on

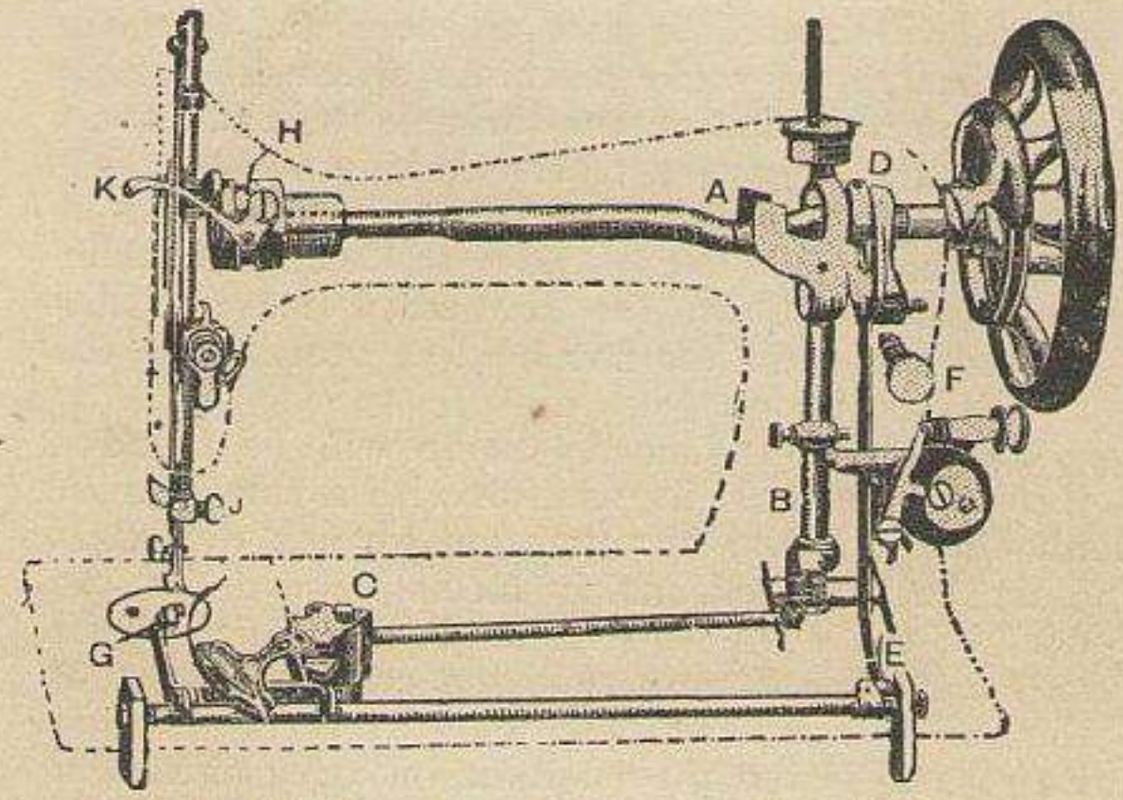


Fig. 26.—Working Parts of Vibrating Shuttle Machine.

the shuttle, after which it rises to assist in drawing up the cotton off the shuttle. The stud to which the roller is fitted is screwed with a left-hand thread, to prevent it getting loose when the machine is being worked. This should be borne in mind when taking a machine to pieces.

It is important that the roller, stud, and cam be kept well oiled, or there will be undue wear upon these parts and consequent trouble and expense.

The needle in the vibrating shuttle machine is

self-setting by means of a flat on the shank and a groove in the needle-bar to correspond; it is therefore impossible to set the needle the wrong way about. It should be placed in the bar as high as it will go, having the short groove toward the shuttle; then make firm the thumbscrew J (Fig. 26).

To fix the needle-bar in position, pass it through the cam (Fig. 27), which is split for the purpose, and screw the small screw very tight, which will cause the cam to close and grip the bar firmly. In some machines there is another small screw which passes through the cam into a hole in the needle-bar, thus making the bar self-setting. If it is necessary, however, to raise or lower the needle-bar in order to make a machine work satisfactorily, the spot-screw may be dispensed with and the bar held in position by the first-named screw.

Just above the needle-clamp will be found a thread-guide, held in position with a small screw. Should this screw be taken out for any reason, it must be replaced, as it forms a stop for the needle; the needle-shank fits into the needle-bar as far as this little screw, the correct setting of the needle thus depending upon this screw being in its place. If the thread-guide becomes nicked, it should be replaced with a new one, as it is likely to chafe the cotton and cause it to break.

The take-up lever K (Fig. 26) is for giving out and drawing up the necessary slack thread which is required to pass over the shuttle to form a stitch. It receives its motion by means of a roller working in the groove of the cam H. This roller should work perfectly free upon its stud and in the groove of the cam; the bearing screw should be a perfect fit, and all the parts should be regularly oiled. If there is too much freedom in any part, replace with a new one. The thread-hole in the end of the lever must be free from nicks.

To remove the upper shaft of the vibrating shuttle machine, first take off the face-plate and take out the needle-bar and presser-bar, with their respective fittings. Next remove the round plate found at the rear of the machine arm, and with a hammer and centre-punch make a dot on the feed cam and another on the shaft to correspond with it; this is for guidance when re-assembling. Then withdraw the long adjusting screw from the shaft connection, and loosen the feed cam set-screw. Remove the take-up lever by taking out its bearing screw. Remove the belt-guard, stop-motion parts, and hand-wheel, and drive out the taper pin from the stop-motion

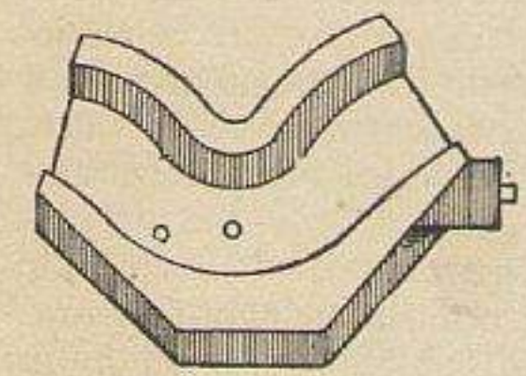


Fig. 27.—Cam.

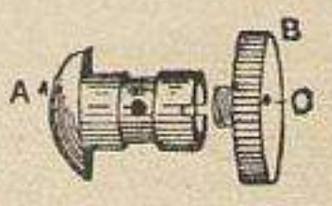


Fig. 28.—Stop-motion.

bushing (Fig. 28). Lay the machine down with the rear side of the arm uppermost, and remove the small set-screw which holds the shaft bearing in position; this is located at the left-hand rear side of the arm. Turn the shaft so that the crank will be uppermost; place a centre-punch at the right or hand-wheel end of the shaft and drive it out, being careful not to jamb the feed cam against the shaft connection. The take-up cam and shaft bushing come out with the shaft, and can be further removed by driving out the taper pins.

The stop-motion (Fig. 28) consists of a cast-iron bushing A, which is made to fit the hand-wheel freely, and is pinned to the upper shaft. It is tapped to receive a large thumbscrew B, and

slotted at the end to receive a steel washer having small projections. Thumbscrew B is drilled and tapped at C, into which is fitted a small spot-screw, with the end projecting from the rear of B about $\frac{1}{8}$ in. The tail of this screw comes in contact with one of the projections on the steel washer, when the thumbscrew B is released and prevents it unscrewing and falling out as the hand-wheel revolves.

Assemble the machine as follows: Place the hand-wheel upon the bushing A (Fig. 28), put the steel washer in the recess and screw in the large thumbscrew B, so that when thoroughly tight the screw-hole C will be rather more than midway between two prongs of the steel washer; then insert the small spot-screw. If the hand-wheel cannot be clamped firmly, or if when the thumb-screw B is unscrewed the hand-wheel is not properly released, turn the steel washer round until correct.

Figs. 29 and 30 represent the shuttle carrier and shuttle. It is important that the shuttle carrier be perfectly smooth at the toe and heel. Should it become sharp or ragged, thoroughly smooth with fine emery cloth. The hole A (Fig. 29) is slotted to allow the carrier to be adjusted sidewise. It should be fixed so as to allow clearance for the cotton in use. If set too far to the right hand, the shuttle will be loose, and will rattle when the machine is in motion; it may also cause the shuttle to miss the loop by rocking away from it. If set too near the left hand, it will bind the shuttle to the side of the raceway, and thus hinder the free passage of the cotton over the shuttle, causing it to break the cotton. As previously intimated, the carrier may be adjusted fore and aft of the needle by means of an eccentric stud at the end of the lever B (Fig. 26).

The shuttle (Fig. 30) is likely to become sharp on its edges and also at the heel; when such is

the case, smooth with fine emery cloth. When threading the shuttle, it is imperative that the bobbin be so placed in the shuttle that the cotton will draw over from the back and not from the under side Having placed the bobbin in the shuttle, apply slight pressure on the end with one finger, then draw the cotton into the slot and under the side spring. The tension may be regulated by the small adjusting screw near the point of the shuttle, which, when turned to the right, will tighten the tension, and turned to the left will loosen it. To obtain the best result, have a very firm tension on the bobbin cotton. If, how-

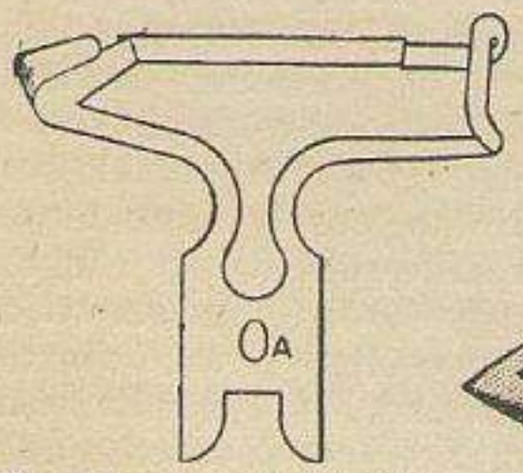


Fig. 29.—Shuttle Carrier.

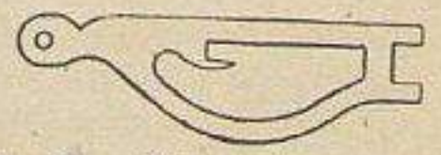


Fig. 31.—Side-spring.

Fig. 30.—Vibrating Shuttle.

ever, the tension is irregular, remove the spring (Fig. 31) by taking out the small screw; clean off all lint or dirt, and if a deep groove is cut in the spring or on the side of the shuttle, remove it by applying F F emery cloth; then finish with O O emery cloth, or fit a new side-spring.

If when fitting a new side-spring it is impossible to obtain sufficient tension when the screw is turned in, bend the spring at that place where the cotton passes under, so that it fits flat to the side of the shuttle. When removing a shuttle from the raceway, never lift it by the side-spring, but depress the point with the thumb and raise the heel with the forefinger.

The bobbin winder fitted to this machine is identical with that shown by Fig. 98 (p. 113).

The method of threading the vibrating shuttle machine is shown in Fig. 32. Place a reel of cotton on the spool pin, and draw the cotton into thread-guide A, between tension discs B, from right to left into the take-up spring C, up and through hole in the take-up lever D, into face-plate eyelet E, behind needle-bar thread-guide F, then into needle-eye G from the left to the right hand. To bring the shuttle thread through the needle-plate hole, hold the needle cotton in the left hand rather loosely and with the right turn the hand-wheel one revolution, and the cotton can easily be drawn up; place both ends of the cotton under the presser foot before commencing sewing. When operating, be careful to have both slides closed to prevent accident to the shuttle or carrier. If either slide fits so loosely as to move out while the machine is being worked, it can be made tighter by bending slightly. H shows a small knife for cutting the cotton. For ordinary purposes use No. 40 cotton and No. 1 needle; for very fine muslin and silk, No. ½ or B needle and No. 60 to No. 80 cotton; for heavy materials, No. 2 and No. 3 needles, with No. 36 or No. 30 cotton.

In some heavy lock-stitch machines, employing very coarse thread for stitching traces, soles of boots and shoes, etc., instead of a needle is used a hook, resembling a short crochet hook, which is sometimes curved, sometimes straight. The shuttle sometimes is placed on the upper part of the machine, so that the shuttle thread may form the upper stitch; this is a great consideration where hot wax is used, as it places less friction on the thread, preventing the wax being rubbed off during the formation of the stitch.

In a perfect lock-stitch the threads should be locked in the centre of the goods. In the manufacture of some articles, a perfect stitch is required from the shuttle thread, the goods being stitched on the reverse side, so that the shuttle thread forms the stitch on the right side of the material.

Machines with more than one needle are usually built on the same principle as a single needle machine, simply having the necessary extra tensions, shuttle, needles, take-up lever holes, needle-plate holes, and relative feed points. When such a machine is used for cloth or calico work, it has a presser foot with holes in it according to the number of needles being used. These machines are adjusted and repaired like ordinary machines,

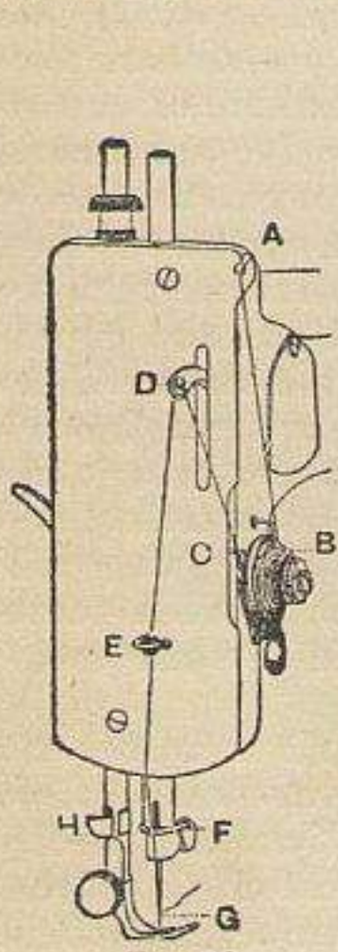


Fig. 32.

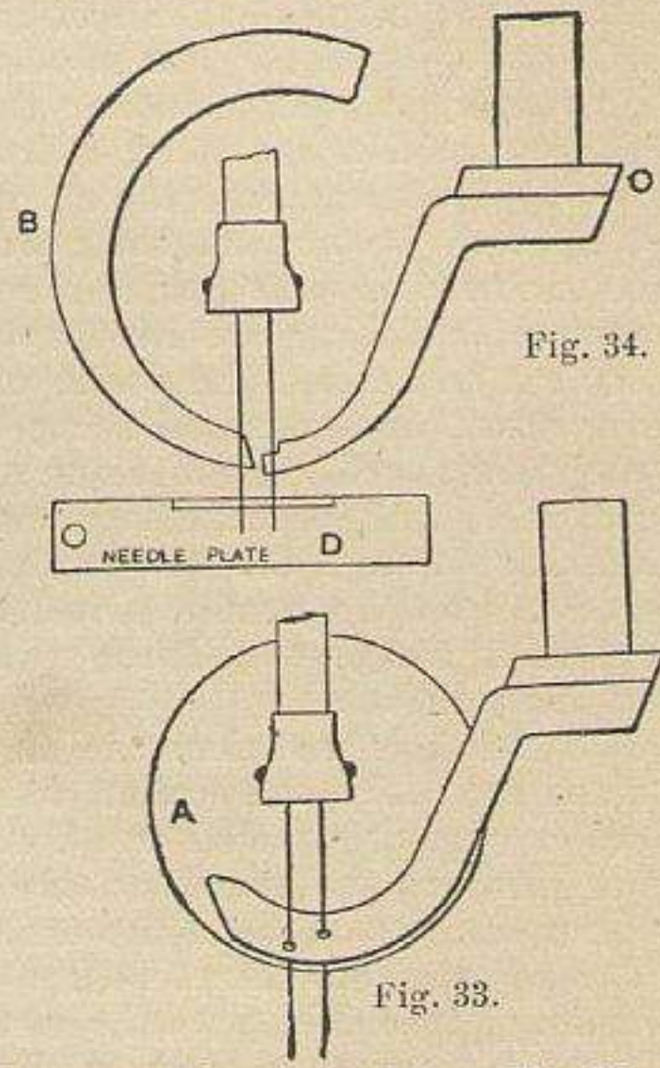


Fig. 34.

Fig. 33.

Fig. 32.—Threading Vibrating Shuttle Machine. Fig. 33.—Twin Needles and Roller Presser. Fig. 34.—Twin Needles and Adjustable Needle Guard.

but the work is complicated according to the number of needles and shuttles.

Twin-needle machines for leather work have special fittings, and require some further instructions. They generally have a roller presser A (Fig. 33) and also an extra needle guard, which sometimes takes the form of a small presser foot with two holes for the needles as shown, thus preventing them springing together or apart. Other machines are fitted with a roller presser and two separate and adjustable needle guards B and C (Fig. 34). Do not set the needle guards so close to the needles as to spring them, but see that the rows of stitching are kept apart. If the guards are set too close, the width of the rows will be increased, and when stitching over a rough seam the needles will spread as they pass through the material, and perhaps, instead of entering and passing through the needle-plate holes, they will descend on the needle plate D and break themselves or the plate. Other adjustments are as for ordinary machines.

Buttonhole machines are of various styles, and some for shirt and collar work are made from ordinary sewing machines. Sometimes the needle-bar vibrates, and sometimes the buttonhole attachment vibrates to form the cross or zigzag stitch. The adjustments therefore are the same as for an ordinary machine, plus the attachment, which in some instances is very intricate, especially in machines fitted with a cutter bar and knife and an automatic stop. Owing to the variety of attachments it is impossible to give definite instructions without dealing with each separate appliance, but a few general hints will serve.

For working a "whip stitch" hole use the same kind and number of cotton for the upper and lower side, generally 40 top and bottom. For working "purl stitch" holes a much finer cotton should be used underneath. The following numbers, showing

upper and lower cottons respectively, will suffice: 70 and 120; 60 and 100; 50 and 90; 40 and 80. Following are some working hints. Do not make stitches extra small; do not have the knife late in its cutting movement, or set too near the rear of the needle; have a light, smooth tension underneath, and keep the tension free from jags on top.

Buttonhole machines for leather and tailoring work make an "eyelet end" buttonhole, using silk at the top and bottom and a thick thread or gimp for raising the purl. The upper silk is carried by the needle, which is actuated by the needle-bar. The under silk is not wound on small bobbins and carried by a shuttle as in a lock-stitch machine, but runs off its own reel and has tension put on it, and is carried by an under needle or looper with a hole. The thick thread or gimp simply runs from its reel through a hole in the needle plate, or button, as it is usually called in these machines, and lies round the edge of the buttonhole, making it stronger and "plumper."

These buttonhole machines may be divided into two classes, A and B. In the A style machine the needle-bar has a zigzag movement from right to left; it descends on the left hand with upper silk, to its lowest point of travel, where the silk is locked by a pair of nipper discs; the needle-bar then rises and the silk forms itself into a loop; the under needle or looper on the left carrying the under silk then moves towards the right and passes into the loop; a spreader on the right moves forward and catches the silk carried by the under needle, and spreads it open, so that the top needle, when it descends again on the right-hand side, passes through the loop; the under needle then retreats, the upper needle forms another loop, and a looper from the right hand moves towards the left and passes into the loop. Next a spreader on the left moves forward and catches one thread of the loop and spreads it, so that the

upper needle, descending again on the left-hand side, passes through the loop thus made, the looper from the left hand coming into action again. The upper silk, actuated by a tension, a take-up lever or spring, and a slack thread movement of the needle-bar, is locked by the under silk and forms itself into small knots on the edge of the buttonhole, producing a very pretty appearance called the purl. Endeavour to make this firm and even. The eye of the buttonhole is shaped by the action of the feed cam, which moves a clamp in the direction required.

In buttonhole machines of the B style the needle-bar does not vibrate, but the stitch is thrown over the edge of the buttonhole by means of a curved needle, and the eyelet end of the buttonhole is formed by the needle-bar moving in a semicircle at the same time as the looper and under needle. The movements are as follow: The needle-bar and needle descends with a silk to its lowest point of travel, then rises slightly, forming a loop; a looper enters this, the upper needle rises, the looper, by a variable motion, spreads the loop, through which an under needle carrying an under silk passes to the upper side of the buttonhole by a semicircular movement until it reaches its limit of motion; then it moves slightly backward, forming the silk it carries into a loop; the upper needle then descends with the upper silk, and passes through this loop, and the whole action is repeated stitch by stitch. The appearance of the worked buttonhole in this machine differs from the A style. It has a purl at the edge of the hole and also a row of small stitches round the outer edge. The punch works mechanically, and when the hole is finished the material is released from the clamp and the machine stops automatically.

CHAPTER III.

WORKING AND ADJUSTING SEWING MACHINES.

In this chapter it is proposed to give advice on the working, adjustment, and care of sewing machines; and by way of introduction a few words on the choice of a machine may not be out of place.

In purchasing a machine at least three things have to be considered: the kind of material to be operated on, the class of work to be turned out, and the speed with which the work has to be accomplished.

Thick cloths, felt, and heavy drapery will require a machine strong in all its parts. The feed must be positive and firm in its action; the needle must be capable of standing a heavy strain and holding a thick thread; the take-up must be strong enough to draw a tight stitch; and altogether the machine must be made on the soundest mechanical principles, and must be of the strongest construction. Most of the best makers make such machines on the principle of their lighter ones, and they are known by the name of tailoring and manufacturing machines (see Chapter VII.). In designing them every part is made amply strong, and light running is but a secondary consideration.

For light materials, such as ordinary domestic sewing, cotton and linen goods, light dress materials, muslins, calicoes, etc., a machine of a very different class is required. A light and easy-running machine is wanted—one which will do the work with the least possible exertion on the part of the operator, who in this case is very often a delicate woman, to whose health a heavy machine

would be a serious danger; so that light and easy-running machines have been designed and called "family" machines (see p. 93).

If first-class work, showing a nice, even stitch and firm and strong, is to be turned out, a good lock-stitch machine is the best; but if the work is simply for show, and great strength of seams is not necessary, a chain-stitch machine will be the best, and will cause less trouble and exertion on the part of the operator.

The question of speed is always a difficult one in all branches of mechanics. A high speed can scarcely be obtained without sacrificing in some way efficiency. Lately, however, makers have turned their attention to this matter, and it is now possible to get a machine which can be driven at almost any speed up to 3,000 stitches per minute.

The effective life of a machine and the cost of its maintenance in good order are largely matters of taking proper care of it. The following rule, as adopted by many of the best manufacturers and printed on every page of their instruction books, should be carefully observed: "No machine will work satisfactorily unless kept properly clean and well oiled."

After the machine has been in use some time, the oil with which it was at first, perhaps, liberally supplied will have become dry and thick by the action of the atmosphere and the dust arising from the materials sewn. In that case the machine should be "run out" with paraffin oil or benzoline until all the old oil is removed and the machine runs quite freely. It should be then oiled again with pure machine oil, the best quality oil being the cheapest in the end. The best oil for the purpose is sperm oil; but as this is very expensive, and rarely obtainable in a pure condition, a light mineral lubricating oil is usually employed. A pale mineral oil of a specific

gravity between ·884 and ·90 could be used without mixing with anything else.

A mixture of sperm oil and paraffin oil has often been recommended; also a good oil can be made by mixing colza oil and paraffin, in the proportion of 6 parts of colza to 4 parts of paraffin.

Always use genuine needles, and, if the machine is not used very often, "run out" with paraffin oil before using, not forgetting to lubricate with the proper oil after using the paraffin. See that the stand runs easily; if it does not, free with paraffin oil, and see that the belt is sufficiently tight to drive the machine.

The care of a chain-stitch machine is, as a rule, a simple matter. See that all parts fit firmly and smoothly, and that all screws and nuts are tight, on account of the high speed at which the machine may have to run. Have all parts that come in contact with the cotton free from nitches and rough places, and if from any cause it is necessary to use emery cloth on the looper, be sure to finish it off smoothly. It is best to finish with No. 00 emery cloth. Use the needles recommended by the maker of the machine.

When the feed of a machine refuses to work it will often be found that it is clogged up with lint from the material worked upon, especially when the machine has been much used on soft dress material.

The use of the wrong cotton is a frequent cause of failure. It is impossible to get an even and regular tension with glazed cotton, and therefore the thread must always be unglazed. The top and bottom threads should also be very nearly alike, or a difficulty will be experienced in getting the locks of the stitches properly buried in the material. Indeed, as a general rule, the same size thread, cotton, or silk may be used for both upper and lower stitch. When even sizes are used, however, it may be difficult to obtain a perfect stitch

on very light material; in such cases, for the shuttle use from one to two sizes less than that of the upper thread. For instance, if 40 cotton is being used on the top, use 50 underneath, or if 16 thread is used on top, use 18 or 20 underneath. If the cotton lies in knots on the surface, the upper tension is too tight, or the shuttle too loose. If it lies in knots on the under side, the under tension is too tight, or the upper too loose. In any case be sure not to make the tension more than the cotton will bear.

The reason for letting the top thread run over a bit of oiled sponge in some sewing machines is that some threads are hard and wiry, and by applying oil they become softened and more pliable, and will pass over the thread guides and through the tension and needle with less friction, causing less resistance, thus greatly facilitating the use of the machine. The reason for oiling the top and not the bottom thread is that the function of the under thread in an ordinary lock-stitch sewing machine is very different and less complex than that of the upper thread, and therefore can be worked satisfactorily without lubricating.

An initial difficulty is the manner of threading the machine.

To thread a Singer boat-shape shuttle machine, place a reel of cotton on the thread-wire, carry the cotton through the thread-guide at the top front corner of the face-plate, down and between the tension discs on the front of the face-plate, up and through the take-up lever, down to the needle-clamp thread-guide, through the needle from the front side, the long groove of the needle facing the operator, and the short groove facing the shuttle. The upper tension may be regulated by a thumbscrew, and the pressure on the foot-bar by another thumbscrew. The tension screw may be on the front of the face-plate, or under the front end of the arm.

A Singer oscillating shuttle machine is threaded as follows: Place a reel of cotton on the thread-wire, carry the cotton through the thread-guide or between the thread-check at the top rear corner of the face-plate, down and between the tension discs on the front of the face-plate, over the thread-wire and into the take-up spring, up and through the hole in the take-up lever, down and through the eyelet at the centre of the face-plate, into the needle-bar thread-guide, and finally through the needle-eye from left to right. Set the needle with its short groove to the right hand or shuttle side. To tighten the tension turn the nut to the right; to loosen it, turn it to the left.

The threading of modern shuttles is a comparatively easy matter, as many are self-threading, or

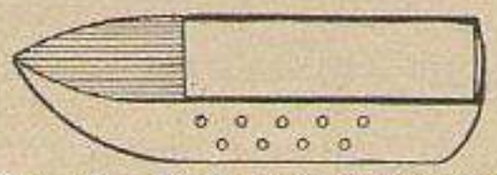


Fig. 35.—Boat-shaped Shuttle.

require but very little threading; but the old style boat-shape shuttle needs a little explanation, as the wrong threading of it often gives considerable trouble. This shuttle generally has several holes through which the thread passes in order to obtain sufficient tension, but this is not the sole object of these holes. By varying the threading, the amount of slack given off by the shuttle can be regulated. For instance, Fig. 35 shows a shuttle which has nine holes in it. The correct way to thread this shuttle is to begin with the top hole nearest the heel, and thread it in and out of the upper five holes, finishing with the hole nearest the point. If the tension then is not strong enough, thread through more holes, but finish at the same hole, the one nearest the point. Theoretically, this is the right method; yet a machine, if threaded in this way, would not always make

a perfect stitch; hence it is necessary sometimes to finish threading a hole or two farther from the point, and sometimes it is compulsory to finish in one of the lower holes. As a rule, let the cotton pass out of the hole nearest the point, and then, if more slack is required, thread back a hole at a time till the right stitch is attained.

The tensions largely determine the quality of the stitching; if this is loopy or poor, adjust the tensions so that the loop is hidden in the material, as the stitch is weak if straight one side. The tensions should pull the stitch equally from each side, and if the stitch is a running stitch, it shows that the tension is tighter that side than the other. Figs. 36 to 38 show the formation of the stitch. Fig. 36 shows the tension too tight on top, Fig. 37

Fig. 36. Fig. 37. Fig. 38.

Fig. 36.—Stitch, Top Under Tension Tight. Fig. 37.—Stitch, Tension Tight. Fig. 38.—Stitch, Tensions Perfect.

the tension too tight underneath, and Fig. 38 the perfect tension. If the shuttle has a spring or springs as tension, see that they are not cut in, and if so, replace. If the shuttle is threaded in several holes, thread in more holes to tighten tensions. The top tension, if discs, should not be cut or scratched, and, should this happen, they must be smoothed or replaced. If the top tension is a wheel tension—as in the Howe and the Wheeler and Wilson machines—see that the wheel turns freely and does not jamb, and that the washers on each side are not clogged with old oil; if they are, cut new ones of felt or stout cloth, or buy others at a depôt.

The curved-needle revolving-hook sewing machine described on pp. 24 to 28 is threaded in the following manner. The moving arm of the machine is represented by Fig. 39.

Place a reel of cotton (No. 40) on the spool wire at the rear of the machine, draw the cotton into the thread check A, around the tension pulley B in the direction indicated by the arrow, thence through the eyelet C to the hole D, and through the needle-eye E from left to right. Fig. 40 shows the threading of the under cotton. Place a bobbin on the long winder spindle, and wind the bobbin

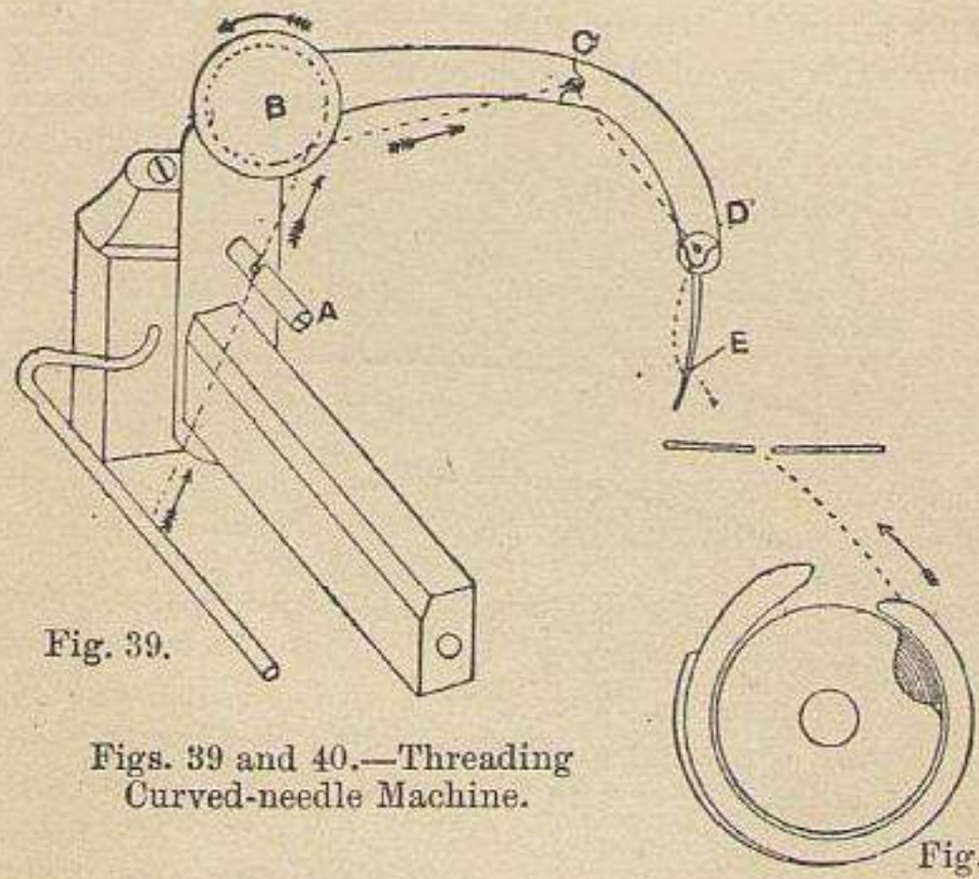


Fig. 39.

Figs. 39 and 40.—Threading Curved-needle Machine.

Fig. 40.

fairly full of No. 40 or No. 50 cotton; then remove the ring slide, and place the bobbin into the cavity of the hook, allowing the cotton to draw from the rear toward the front, as indicated by the arrow. Bring up the ring slide as close as the stop-screw will allow, and tighten the set-screw. To begin sewing, raise the presser foot and place the goods to be stitched on the cloth-plate, drop the presser foot, hold the upper and lower threads in the right hand, and begin to sew by turning the cam wheel away from the operator.

The method of threading an old type of Howe machine still found in use is illustrated by Fig. 41. Place the cotton on the spool-pin A, then lodge the cotton in the nipper B, around the tension pulley C in the direction indicated by the arrows, thence to the thread-guide D, through the needle-bar at E, down the face-plate in front of the stud F, into the hook or eye of the side spring G in front of the stud H, to the needle-bar thread-guide J, and through the needle-eye from left to right. The tension pulley should revolve as the cotton

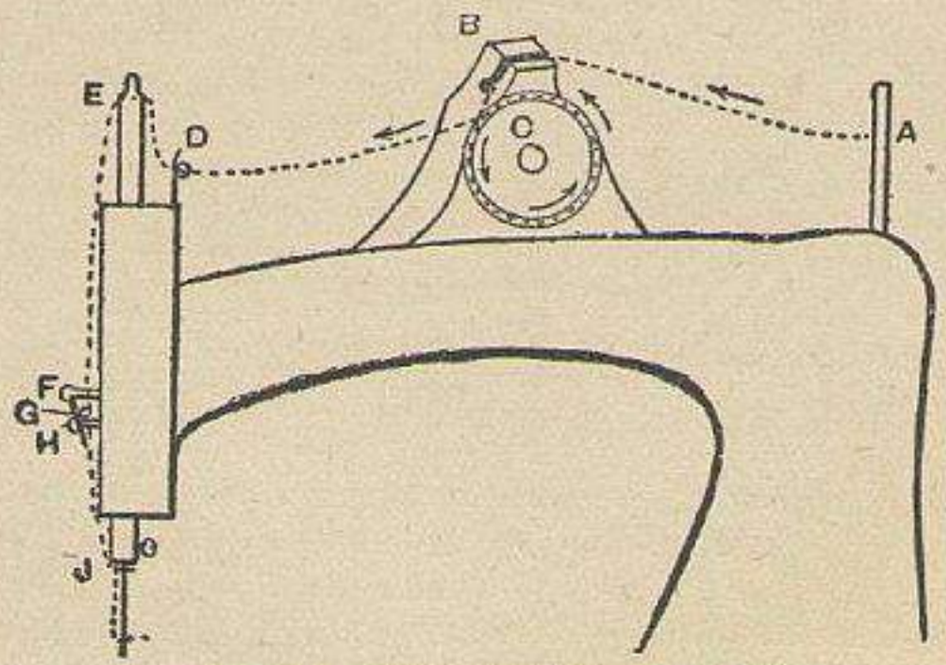


Fig. 41.—Threading Old Howe Machine.

is drawn off. See that the felt washers are soft and well oiled or the pulley may remain fixed, causing the cotton to slip and produce a bad tension.

Shuttles of Howe machines are threaded as follows: Place the bobbin in the shuttle so that the thread draws off from the rear side, then thread through the hole A (Fig. 42) in the back of the shuttle nearest to the heel, back through B into C, back through D, under the tension-adjusting plate, then through hole E into hole F, and finish by drawing the thread through hole G. The

tension may be adjusted by turning the small screw H, which is left-handed—that is, turns in an opposite direction to that of the hands of a clock. If more tension is required than can be obtained by the tension screw, thread through more holes: the five extra holes by G are for this purpose. It is usual to finish threading in hole G, which is nearest the point of the shuttle.

In working the Howe sewing machine of modern make, the following hints may be of service: First, get the machine to run backwards, or from the operator, quite easily; if at all stiff, use paraffin oil. Thread the shuttle as just described. The needle is set with the short groove towards the shuttle, and with the eye level with the needle-

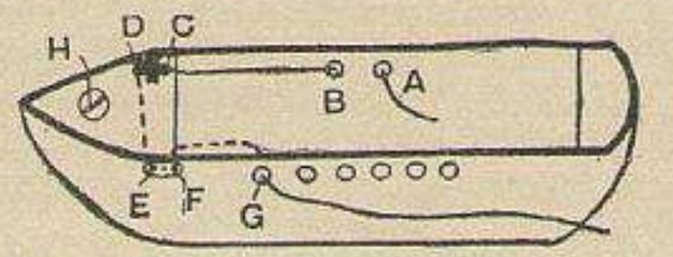


Fig. 42.—Threading Howe Shuttle.

plate, when the mark or scratch on the bar is just flush with the top of the face-plate or part containing the needle-bar and foot-bar, etc. If there is difficulty in obtaining needles, use a Singer arm-machine needle, cloth point if for cloth work, leather point if for leather. The top cotton threads round the tension wheel once or twice, then under the small thread guide just behind the needle-bar, then in the slot in the top of the needle-bar, down through the eyelet in front of the spring, through the spring, back through the wire eyelet again, and through the needle, threading towards the wheel end. The stitch is altered at the screw in front of the arm, and the top tension is tightened or loosened by altering the brass thumbnut in front of the tension wheel.

The operation of setting a needle in any

machine always obeys the following rule: All needles have two grooves, generally a long one and a short one, and the short groove always faces the shuttle, hook, or looper. Some special needles have two long grooves, but that does not interfere with the setting of them, as one groove in such a case would be equal to the other. First notice on which side of the shuttle the needle stands, then place the needle so that the short groove faces the shuttle, bring the shuttle, by turning the wheel, up to the needle, set the needle eye from $\frac{1}{16}$ in. to $\frac{1}{8}$ in. below the shuttle point, and always thread the needle from the long groove side. For instance, if the needle stands on the right of the shuttle, set the short groove to the left. If the needle stands at the front of the shuttle, set the short groove to the back, and so on.

The feed is that part of a machine which carries the material along. It is made in various styles according to the class of goods to be stitched. All feeds fall into two classes: (*a*) drop or step feed, (*b*) wheel feed. The drop or step feed is most commonly used, and is called by these names on account of its double action. Its first action is to rise slightly above the needle-plate, and its second is to move onward, the distance of this movement being adjustable according to the length of stitch required. These movements are obtained by two cams, or one double cam, the return movement being accomplished by a fork or spring. (*b*) The wheel feed is used principally in the leather trade, and, as its name signifies, is a wheel and has but one action. The feed wheel can be set above the needle-plate as desired, but where it is set, there it remains a fixture—simply moving round in order to carry the material along at a given time. This kind of feed is more steady in its action, and where hard and uneven material is operated it is certainly preferable.

With regard to timing the feed, on account of

the variety of machines on the market, as well as the intricate complications of feed movements, it is impossible to give one rule applicable to every machine, but it is possible to make a statement that will be a guide. For all sewing machines used for household work, time the feed to begin taking the material along when the needle is well out of the work, but not so late as to allow the needle to enter the goods again before the feed has finished its onward movement. In machines of a modern make that have a take-up lever actuated by a take-up cam, time the feed to finish its

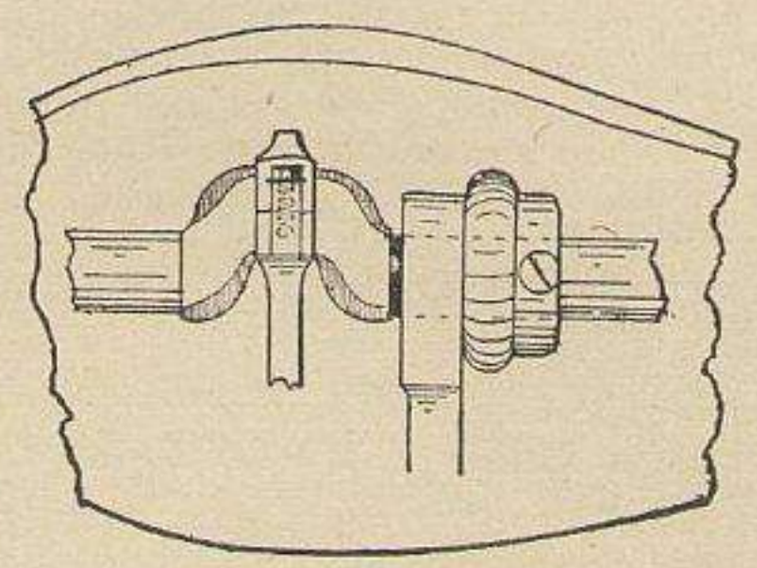


Fig. 43.—Feed Cam in Oscillating Shuttle Machine.

onward movement when the take-up lever has reached its highest point of travel.

Some machines are fitted with a top feed, the time of which is just the same. Some are fitted with both top and bottom feed; this is an advantage in tailoring and such-like work, preventing pushing and puckering, especially when cloth is cut on the bias.

A Singer oscillating shuttle machine itself cannot get much out of order; neither can it get out of time, except at the feed cam, which is fixed with a set-screw on the upper shaft. The feed should rise when the needle is out of the work, and

complete its travel and drop before the needle reaches the work again. If it does not, loosen the screw, and turn the cam around a little on the shaft and then tighten up again. Turn the cam

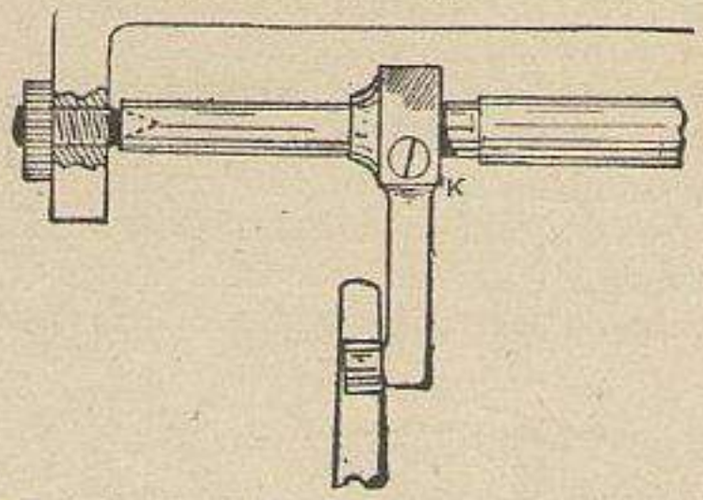


Fig. 44.—Raising Feed in Oscillating Shuttle Machine.

towards the top of the arm to quicken the feed, and in the opposite direction to make it slower. The arrangement of the feed cam is illustrated by Fig. 43.

To raise the feed on the newer style of oscillating shuttle machine, with a shuttle as shown by Fig. 63 (p. 91), slacken the screw K (Fig. 44)

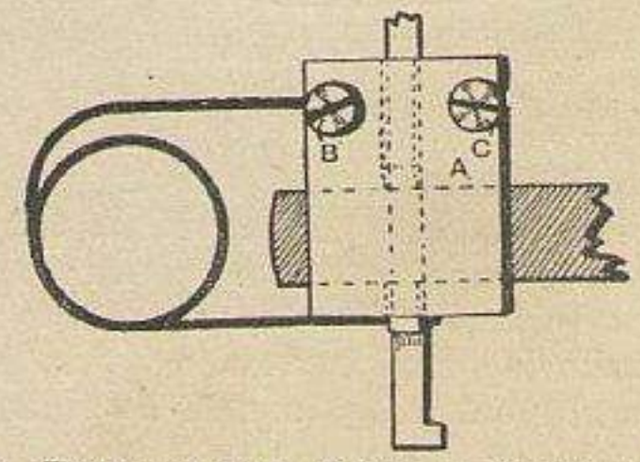


Fig. 45.—Feed and Cam of Singer Family Machine.

underneath the machine. Push the feed up by twisting the lever forward slightly and tighten the screw K. See that the feed drops well below the needle-plate when down to the lowest point.

In old-style machines, the feed is altered in a different way. Probably the machine is fitted with a cam underneath, as in Fig. 45, where A is the cam, and B and C the two screws holding it in position. To alter the feed, loosen the two screws and move the cam slightly to the left to raise and to the right to lower; then tighten the screws firmly. In medium machines of the same type, the cam is as shown in Fig. 46, where the screw is loosened and moved to the right to raise and to the left to lower.

If the machine is not fitted in any of the ways

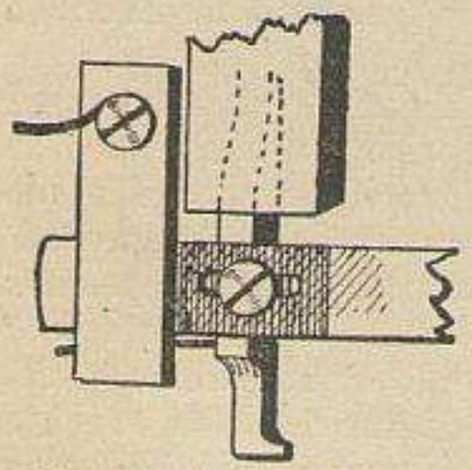


Fig. 46.—Feed of Singer Medium Machine.

Fig. 47.—Another Type of Feed.

explained above, the feed is probably fixed by a screw as in Fig. 47; this screw can be loosened, the feed raised a little, and the screw tightened up again. The piece N P is the needle-plate.

Irregular feeding results from: low feed, feed wanting cutting, feed fork or other feed parts worn, insufficient pressure on presser foot, or roll presser wheel sluggish or screwed up too tight. In wheel feeds the causes may be: worn feed driver or latch or dog, feed dog spring or driver spring too light, feed parts want cleaning or feed wheel worn. Cast-iron feed wheels should be kept dry and not oiled, but on steel wheels use paraffin oil for cleaning.

When a Singer medium machine feeds badly —the material to be sewn stopping in the one place, and the feed working without clearing it— it will probably be found that the feed is choked up with dirt and old oil. Take off the needle-plate, and slide out the narrow slide that fits in the bed of the machine, just in front, and carefully clean out the dirt and replace the slide and needle-plate. If it is the right height, the feed should take the work along, unless it is blunt; if so, soften it until blue in a gas flame, file up sharp, and then harden again. See that the foot bar slides easily, and that the foot bears equally on both sides; also see that all screws underneath are tight.

By the time of a machine is meant the exact movement of the needle with relation to the shuttle, so that a loop is formed in time for the shuttle to enter it. This varies somewhat, according to the class of material being worked. As a general rule for modern machines, either rotary or reciprocating, allow the needle to rise from $\frac{3}{32}$ in. to $\frac{1}{8}$ in. before the point of the shuttle reaches it; but when the goods are heavy it will be found necessary sometimes to make the shuttle slower, and lower the needle-bar to compensate for this. If the general rule does not apply, time the needle, throwing a bold loop, and letting the shuttle just enter it when it is fully made. In some old-style machines the needle rises as much as $\frac{3}{16}$ in., but when it has done that it remains stationary until the shuttle has entered the loop sufficiently, whilst in modern machines the action of the needle-bar is continuous, and the shuttle must act accordingly.

In timing sewing machines it may be taken as a general rule that the needle and shuttle start together—that is, the shuttle must have reached the full extent of its backward movement when the needle-bar is at the bottom of its travel, and

as soon as the needle-bar commences to rise the shuttle should start to move towards the needle. The theory is, that the needle should be able to move sufficiently to throw out a loop of cotton for the shuttle point to enter before the shuttle reaches it. If it is not possible to let the needle and shuttle start together, let the needle have just a little start.

If a revolving-hook machine gets out of time, the point of the hook should be made to come a little behind the needle, say, roughly, $\frac{1}{4}$ in., and when the point of the hook has reached the needle, the eye of the needle should be about $\frac{1}{8}$ in. below it. In a Wheeler and Wilson machine the hook is held in position by two screws on the hook spindle; they are the nearest screws to the hook.

The take-up spring is named sometimes the check spring, or thread-controller spring, the latter explaining its use. It really controls the surplus slack thread given off by the take-up lever, and keeps it out of the way of the needle point. Very much depends on this small part. The spring is extremely sensitive, and must be regulated with great care; in fact, only experience can properly teach how to adjust it to the various materials now stitched.

The styles of check springs are numerous. In old-style machines the spring is on the face-plate, and is spiral at one end and terminates with a loop. In other machines it takes the form of a pair of discs actuated by a light spring, whilst in modern machines it may be found near to the tension, and is made adjustable in pressure as well as in movement; indeed, on the latter type of machine it is connected with the presser bar, and its movement is regulated according to the substance of material being sewn. To adjust it for ordinary household stitching, have a medium pressure of spring, and regulate it so as to finish its action when the needle point has reached the

surface of the material. For light leather work have a medium pressure, and adjust it to finish its action when the needle eye has reached the material. For very heavy leather work have a heavy pressure, and regulate it to finish its movement when the needle has entered the goods halfway to the needle eye.

When machines are running at a high speed it will be found necessary sometimes to have exceedingly light pressures, and to give the spring more movement, that is, let it be longer finishing its action; in this way the cotton is kept from becoming strangled on the shuttle, or caught in the shuttle raceway. However, never have the pressure on the controller spring heavier than the pressure put on the cotton by the tension discs or pulley.

In vibrating and oscillating shuttle machines the thread is simply drawn round the shuttle and passes off with very slight resistance, whilst in some rotary hook machines outlets or openings for the thread have to be made; this action is called "the variable motion." This perhaps can be better explained if classified as follows: (*a*) vibrating or boat-shaped shuttle; (*b*) oscillating or reciprocating shuttle; and (*c*) rotary hook or shuttle. In class *a* the thread outlets for the vibrating shuttle are two in number, one near the point, the other at the heel; in class *b* the thread openings for the oscillating shuttle are two in number, one at the neck, the other at the heel; and in class *c* the thread openings for the rotary shuttle are three in number, one just past the point, another at the neck, and the third one at the heel.

In the last case, if the thread made its own openings it would become tangled when the machine ran at high speed; hence the necessity of a variable motion, by which the shuttle carrier or driver varies its relation with the hook or shuttle. Thus when the hook point enters a loop the

hook is being driven onward by the heel of the carrier, there being a passage for the thread in the two first openings; but when the thread has passed the neck of the hook, the carrier alters its relation and drives the hook from the rear of the point, thus closing the first passage and opening the third, and allowing the thread to pass the heel without any resistance. In all rotary hook machines driven by a driver or carrier, see that these openings work in time and are sufficiently large to allow the free passage of the thread. More passage can be given to the first opening by tilting the hook race slightly with a piece of paper.

In some machines a small adjusting screw is fitted in the race; other machines have an adjustable eccentric. Constant use causes the shuttle to wear and rock about sideways in the raceway or ring. Consequently, when sewing anything very thick, the needle is likely to incline from the perpendicular and get the wrong side of the shuttle, and this can to a large extent be guarded against. The shuttle carrier may be raised so that the needle will just bear against it, but the carrier needle guard must not be too high or the loop will be destroyed. Modern machines have raised carriers, but the needle, constantly rubbing against them, wears them away and they need rebuilding, which can be done by filing the old rise away and soldering another piece on; or in some machines very thin metal washers are made by the machine company so as to pack out the carriers as they wear. If the shuttle or hook becomes very loose sideways it should be replaced by a new one. Before piecing a carrier, be sure that the needle-bar is firm and the needle quite true.

Presser feet are made to correspond with feeds in various shapes and sizes. Their functions are first to hold the material firm whilst the needle

penetrates and forms the loop; secondly, to press the material against the feed whilst the length of the stitch is being made. See that the needle goes through the centre of the hole or slot, and that the foot beds squarely and firmly on the needle-plate; if it does not, bend it or file it until it does. The roll presser is designed for passing over hard and uneven seams and rough places, and is used principally in the leather trade. It acts as a needle guard as well as a foot. It should be set central with the needle, so that the needle just touches it; in this way a perfectly straight row of stitching can be produced. See that the roll presser wheel does not bind on the bearing screw.

Hints as to the causes of and remedies for many of the troubles experienced in operating sewing machines will now be given. Three of the principal troubles, broken needles, broken thread, and missed stitches, are considered separately in the next chapter.

Looping underneath is caused by: a broken take-up spring; tension too loose on top; notches in the neck of the shuttle; incorrect variable motion; take-up spring too high or of too light a pressure; needle-plate hole too small; needle jammed on one side of needle hole; heel of the shuttle carrier rough and notched; shuttle carrier too far forward; take-up cam worn out; or take-up cam roller worn out.

Looping on top is caused by: tension too loose; broken take-up springs; or under tension too loose.

Looping in a Weir machine (a small machine fitted with the hook motion shown by Fig. 48) is probably due to the roughness of some of the parts. In Fig. 48, N is the needle and C the cam which works the disc. There are several causes, probably, which contribute to the loops on the material—that is, if they still occur after the tension is tight. Most probably the looper is cut up rough, and holds the cotton loop for too long a period, causing too much cotton to be drawn off; or the looper may not be adjusted correctly. If it is dipping too much, it would hold the cotton; or if not enough, then it would drop the cotton too soon. This can be altered by loosening a set-screw and shifting the piece of metal to which the looper is screwed. If the metal piece is raised, the looper dips less, and *vice versâ*. Possibly the machine may be out of time.

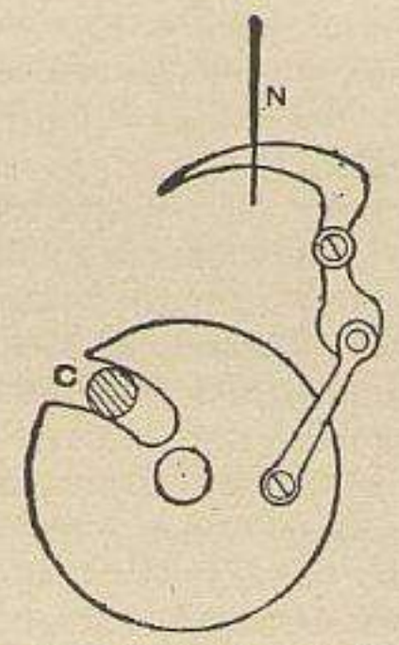


Fig. 48.—Weir Hook Motion.

When a Singer oscillating sewing machine, instead of locking the stitches as it works, just forms one loop into another so that the thread can be drawn out after the stitching is finished, a likely cause is faulty tensions, especially if the loops are left on the underside of the work. If the tensions are altered without good effect, perhaps the roller on the take-up lever or check lever is badly worn, and does not allow the lever to pull up all the slack thread, or the cam-wheel in which the roller works may be worn, with a similar result; or it may even be caused by the absence of a

check spring. Another cause may be that some small roughness or projection on the shuttle or shuttle driver may hold the cotton slightly, and so stop the lever from drawing up the slack cotton. If the tensions are all right, the defect is caused by one or other of these things, and the result is that more slack cotton is thrown out than can be pulled up again. Also see that the needle is large enough for the cotton, and not too low.

When stitches have a zigzag appearance on the upper side of the material, the likely causes are: broken or light take-up spring; tension, needle-bar, or presser-bar, too loose; roll presser too far from needle; hole in needle-plate too large; or feed too high.

Irregular stitching of a Singer oscillating shuttle machine is probably due to the feed points being too smooth or not high enough above the needle-plate. If too smooth, remove the feed and have the teeth sharpened; if too low, loosen the feed-point set-screw and raise the points to at least $\frac{1}{32}$ in. above the needle-plate. Do this when the needle-bar has risen to its highest point of travel.

In a Bradbury family sewing machine needing adjustment, trouble may be caused by the needle, when it comes down, not leaving enough slack thread to loop over the shuttle when this passes along. There is a device called a slack-thread pin in the top of the needle-bar, and if this is screwed lower in the bar more slack thread will be thrown out. If the machine is in proper adjustment as to time, etc., the needle will begin to rise just before the shuttle begins to move onward.

If a Singer old-style machine gets choked after making a few faulty stitches, probably the checkspring is broken, and consequently the loops are not pulled up. Or perhaps there is a roughness in the shuttle or shuttle carrier, causing the looping. If it is an oscillating shuttle machine,

a roughness on the shuttle or a worn roller on the take-up lever may be the cause of the trouble.

The causes of irregular tension are: tension discs or stud worn; take-up spring too heavy or too light; incorrect variable motion; shuttle carrier too far forward; insufficient opening between the shuttle and carrier; shuttle tension spring worn; bobbin retaining spring too heavy or too light; bobbin too loose in shuttle; bobbin case holder or fork too near to bobbin case; shuttle or hook too late; shuttle too loose; or shuttle notched in neck.

Drawing thin material into gathers results from: tension or take-up spring too tight; presser foot cut by feed; feed too high or too sharp; or roll presser sluggish.

When a Singer machine works well at a rate of 500 stitches per minute, but makes a larger stitch when the speed is increased to 1,000 stitches per minute, most probably the fault will be found in the parts immediately attached to the feed wheel. The brake roller may be worn, or the spring weak, allowing the wheel to be jerked round farther when driven at greater speed. If this is remedied, and a moderate pressure put on the plates which keep the wheel in position in the frame, the machine can be worked at an increased speed.

The winding of the upper cotton round the shuttle is a defect in revolving hook and shuttle sewing machines which is sometimes difficult to remedy. First of all, the source of the defect must be determined. It may be caused by (*a*) the upper tension; (*b*) the take-up lever or its substitute; (*c*) the hook or shuttle (Figs. 17 to 19, pp. 25 to 27); (*d*) the upper thread check; (*e*) the lower thread check; (*f*) the ring slide or bobbin holder J (Fig. 14, p. 24).

(*a*) If the tension is at fault the amount of slack cotton required is drawn on the hook or shuttle.

but is unable to pass off again for want of more tension to detach it and draw it into the goods. The remedy is to try the cotton by pulling some from the tension; if it should pull loose and irregular, remove its parts and well clean them. Sometimes there is a felt washer on each side of the tension wheel or pulley; these washers become hard, and frequently have a bad effect upon the tension. When this occurs, soak the washers in oil and well rub them between the fingers until soft and clean, or new ones may be cut from a small piece of cloth or felt. This done, replace all tension fittings and adjust very carefully, not putting on more tension than the cotton will stand.

(*b*) The take-up lever, or the part that controls the slack thread, is sometimes actuated by a spring, which is very frail, and the constant motion of the lever, combined with the pressure caused by drawing up the slack thread, causes the spring to break. The action of the lever is thus impeded, and the cotton hangs around the shuttle. The only remedy for this is a new spring.

(*c*) A worn hook or shuttle. The constant tension and friction of the thread will wear nicks, and sometimes deep grooves, in those parts over which it passes. This is particularly noticeable in circular hooks and shuttles. The groove is generally worn in the neck of the shuttle, that being the place where the tension is the greatest. This groove, when deep, will prevent the free passage of the thread over the shuttle, and if there is sufficient elasticity in the thread it will remain in a loop on the hook; this happens more often with silk than with cotton, the latter generally breaking. The remedy is to take out the hook or shuttle and carefully rub with a strip of No. F emery cloth until the groove is worked out; then thoroughly smooth with a strip of No. 00 emery cloth, or a piece of string; replace the hook, and adjust the upper tension.

(*d*) The upper thread check. Near the tension may often be found a thread check, which may be in the form of two small discs actuated by a very frail spring, or it may be a hollow stud with a slot cut in it to receive the cotton, whilst in the tube part may be inserted one or two discs and a spring. No matter what the construction may be, its function is the same—that of checking the cotton and preventing it overflowing into the tension. Sometimes dirt or lint will accumulate, and thus the thread check will fail to serve its purpose; and if the tension is in the form of a wheel or pulley the cotton will slip loosely around it, no

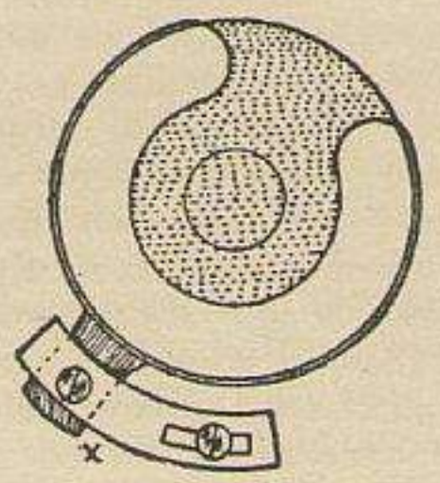


Fig. 49.—Brush in Revolving Hook Machine.

tension being obtained, which will result in the cotton becoming stranded round the hook. The remedy is very simple. Clean the parts of the thread check, and adjust it so that it will slightly pinch the cotton as it travels through.

(*e*) The lower thread check. In some circular hook machines the cotton has to be held upon the hook for a little while. For this purpose a thread check or brush is fixed near the rotating hook or shuttle, as described on pp. 27 and 28, and now shown by x (Fig. 49). This brush may accidentally become pressed too hard upon the hook, and so prevent the cotton being drawn off. The brush should be very carefully adjusted, so as to hold

the cotton lightly until the point of the hook has securely entered the loop that has been formed for the next stitch, by which time the cotton should be released. The adjustment of this brush is made by means of a small set-screw, the loosening of which regulates the brush to or from the hook. Be sure to fasten the set-screw firmly after having properly adjusted the brush.

(*f*) Ring slide or bobbin holder J (Fig. 14, p. 24). In many machines the bobbin is held in position in the cavity of the hook or shuttle by means of a slide formed at a right angle, the upper portion of which is shaped like a ring or circle. The upper and lower rim of this ring is made to stand out rather more prominently than the other portion, and is generally given a rounded finish. Underneath the circular part of the ring slide there is fitted an adjusting screw. When the ring slide is placed in position, the head of this screw takes its bearing against the frame or casting of the machine, whilst the prominent portions of the rim referred to above provide a means of support to the bobbin, and keep it from falling out of the hook cavity or recess. The whole slide is held tightly in position by a thumb- or set-screw. Now the constant rotating of the bobbin gradually wears these prominent parts of the ring slide, and instead of being rounded they become flat. This allows the bobbin to fall outward, and the cotton in its passage round the hook, instead of falling over the bobbin, is permitted to fall into it, thus causing a constant winding of the upper thread round the bobbin. Exactly the same thing happens if the adjusting screw referred to becomes screwed outward. A little dirt on the head of the adjusting screw, or on the casting against which the adjusting screw bears, is sufficient to cause this defect.

The remedy is first to remove all dirt and again test the machine. If there is no improvement.

give the adjusting screw about half a turn; then, if better, adjust the screw so as to allow just enough room for the cotton to pass freely over the bobbin. If, when that is done, and the machine works more smoothly, but occasionally the cotton winds around the bobbin, examine the ring slide; should the elevated edges of the rim have become flat, the ring slide must be refaced.

Refacing the ring slide is done as follows: Hold the slide in a vice, and with a 4-in. or 6-in. second cut half-round file, recess or file out a little very evenly from the lower parts of the rim; then proceed to reshape the two worn edges that have become flat, making them rounded, and working the highest part to the centre. For instance, suppose the elevated portion of the rim measures $\frac{1}{4}$ in., and the rim at that part is $\frac{1}{8}$ in. wide; make the rounded part $\frac{1}{4}$ in. long and the highest part of elevation $\frac{1}{16}$ in.—that is, half the width of the rim. The ring slide must be thoroughly smoothed with fine emery cloth until there is not a rough or jagged place left. Care should be taken not to alter the shape or the angle.

When refacing a ring slide, a steel square should be used. Place one blade of the square against the bottom of the slide, the two elevated edges of the ring being parallel with the edge of the other blade of the square. If perfectly true, the bobbin will bear equally upon each elevated edge of the slide. The reason for recessing the other portion of the ring slide is to make clearance for the cotton, and to put as little friction on the bobbin as possible.

On one side of the ring slide (usually the right-hand side looking at it when fixed to the machine) will be found a flat; this is for the purpose of giving clearance for the cotton just at the point where it is cast off the hook over the bobbin.

If much has to be recessed out of the ring slide during the process of refacing, it will be necessary

to file a little off the flat part; but this will be better judged when the machine is threaded and worked a few stitches. Get the hook at the position where it will cast off the cotton over the bobbin, and notice if the cotton is held by the ring slide just at that moment; if so, file off a little until sufficient clearance is obtained. Should the ring slide be set too close, the cotton will wind round and round the hook. It is sometimes necessary to adjust this slide when using cottons of different size, as a coarse cotton requires more space than a fine one. No. 40 is generally used, and if the ring slide is adjusted for that size it will be correct for ordinary purposes.

Some machines have a fork instead of a ring slide to hold the bobbin case in position; and should this fork press too tightly against the bobbin case the cotton will be retained. If this should occur, bend the fork until sufficient clearance is obtained.

Revolving hook curved needle machines are not liable to get out of time, but should the needle not dip close to the point of the hook the arm carrying the needle can be shifted by altering the two cone screws A B (Fig. 50). Care should be taken that the hook is quite smooth and sharp at the point, and also that it is not roughly used, as, being hard, it is easily broken. The feed in these machines is operated by a cam fixed at the back of the hook, so that the feed cannot be altered in time without the hook being altered also.

In the Wheeler and Wilson D10 machine, the take-up lever slide is adjusted by a small screw A (Fig. 51). The slide is made in two parts; and by turning the adjusting screw these parts are opened and thus tightened in the groove of the cam.

To set a curved needle in a revolving hook machine, loosen the needle yoke by means of a wrench; place the needle shank through the small hole in the yoke, having the long groove to the

left hand; then screw the yoke up firmly. See that the needle passes through the centre of the hole in the needle-plate; if it does not, bend it until it does. Turn the wheel until the hook point reaches the needle, when the eye should be $\frac{1}{8}$ in. below the point of the hook. However, in some machines the eye of the needle should be set level

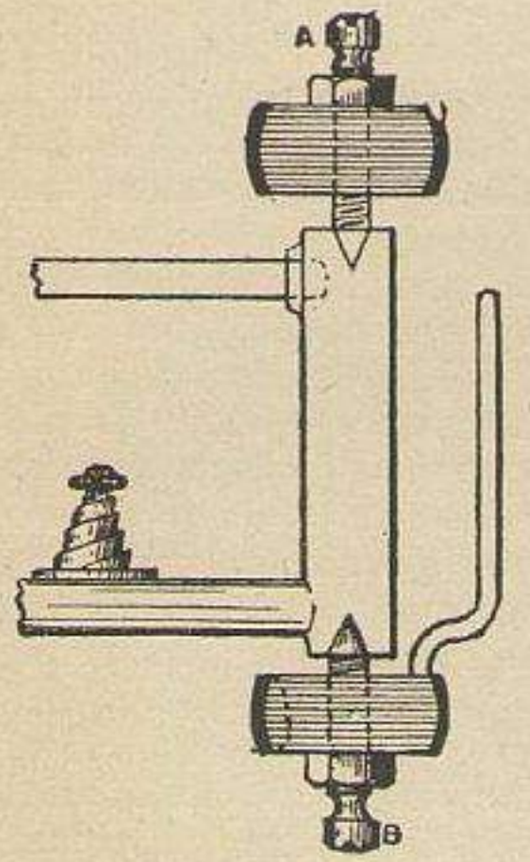


Fig. 50.—Part of Framework with Cone Screws.

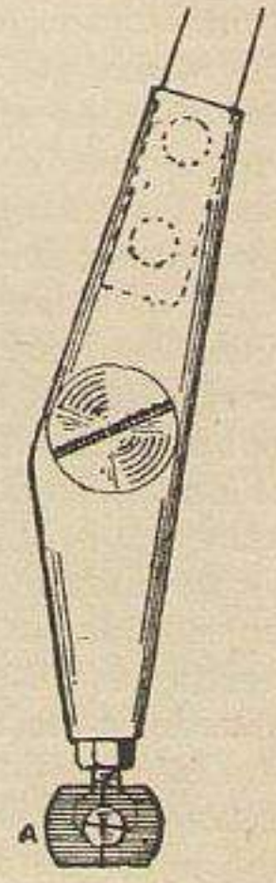


Fig. 51.—Thread Take-up Lever.

with the washer or back part of hook when the point of the hook is just up to the needle (see Fig. 17, p. 25). When turning a square corner, raise the needle till the eye is nearly out of the goods, draw the thread upwards from the eye of the needle until quite tight, raise the presser foot, and turn the material to the desired angle and proceed to sew.

To time the hook of a curved needle machine the needle should be set so that when the point of

the hook just reaches it, the centre of the eye will be level with the top edge of the back part of the hook (see Fig. 17, p. 25). Thread the machine with cotton and have the stitch about $\frac{1}{20}$ in. long, and begin to sew on two thicknesses of unbleached calico. Turn the machine with the hand and stop it the moment the loop is cast off the hook on to the bobbin. Raise the cloth presser and see whether the eye of the needle is $\frac{1}{16}$ in. above the cloth. (This is how it should be.) If it is too high, lower it half the distance it is too high, and again time the hook by the needle; if the needle is too low, raise it half the distance and re-time the hook.

The stroke of the needle arm of a curved needle revolving hook machine is determined by the short lever s (Fig. 13, p. 23). When the arm is at its lowest point, the centre of the needle clamp should be $\frac{5}{8}$ in. from the cloth-plate, and at its highest point barely $2\frac{3}{16}$ in. from the cloth-plate. The needle clamp should move about $1\frac{1}{2}$ in. from highest to lowest position. A handy gauge (Fig. 52) for testing these distances can be made from sheet steel, 3 in. by 3 in. by $\frac{1}{16}$ in.

To regulate the tension of the under thread of a revolving hook machine in which no special device is fixed, the thread should draw from the spool quite freely, the spool, when unwinding, turning towards the operator. The spool is held in position by an adjustable ring slide J (Fig. 14, p. 24). If the spool has too much play, the upper thread, instead of passing to the front side of the bobbin, will fall inside and break; in such a case, remove the ring slide and screw in the adjusting screw H a little. Care must be taken not to set the ring slide too tight against the spool, or it will impede its free movement, which is imperative to the perfect working of the machine.

To set the brush in a revolving hook machine, make the stitch $\frac{1}{20}$ in. long. Use two thicknesses

of unbleached calico only. Set the segment which holds the brush about $\frac{1}{8}$ in. above the lowest point to which it can go, and so that the left edge of the brush will be even with the point of the hook. Set the brush so that the lower two-thirds will touch the hook; but it must not be pushed so hard against the hook as to divide the bristles nor press against the chamfered part of the hook. After the brush straightens the loop across the bobbin, the needle arm should descend $\frac{1}{32}$ in. only. If it does not, lower the segment. The thread must be perfectly free from the brush when the point of the hook has entered the new loop $\frac{1}{4}$ in.

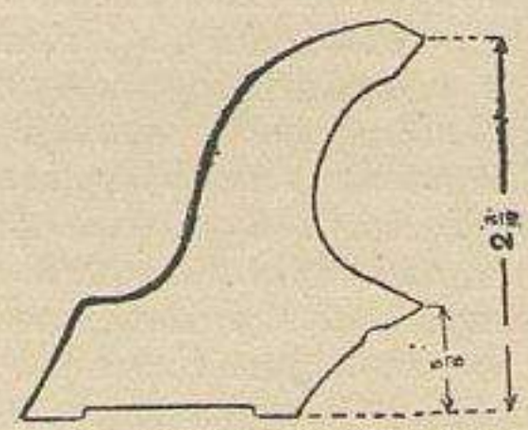


Fig. 52.—Gauge for Testing Stroke of Curved Needles.

Buttonhole machines may give trouble by looping, the causes of which, in the A style machine (see p. 43), are: Notches on the under looper or spreaders; left-hand looper bent downwards or not inclined upwards enough; silk trapped between the spreader and looper; tensions too loose; take-up spring too light; stitches too small or close; width of bite too great.

In the B style buttonhole machine (see p. 44) the fault is generally due to the looper being notched or timed wrong, or the heel of looper in its backward movement catches the under needle. Also the take-up lever underneath may not have sufficient movement (which is adjustable), and stitches may be too small or too close.

CHAPTER IV.

ADJUSTMENTS FOR BROKEN NEEDLES, BROKEN THREAD AND MISSED STITCHES.

BREAKING of needles is most generally caused by the needle touching and striking the needle-plate or the shuttle, and the first thing to do is to see that the needle is dipping quite perpendicularly. If it is not, take out the bar, get a new needle, and file out the groove until the needle does dip perpendicularly. This can be tested by holding a straightedge s against the sides of the bar T (Fig. 53) and holding both between the eye and the light. The needle should be parallel with the straightedge. When true, replace the needle-bar in the machine, and if the face-plate is adjustable —as in the Singer old style machines—adjust the bar so that the needle just clears the point of the shuttle; then adjust the needle-plate so that the needle clears the hole in the plate all round. The plate should guard the needle from striking the shuttle by being placed as close to the back of the needle as is possible without touching.

Needles are sometimes broken by the operator pulling the work along. This should not be necessary, as the feed should carry the work, except, perhaps, over extra thick seams. If the teeth of the feed have got low, raise the feed slightly, but not too high. When the work is pulled through by the operator, the needle is drawn on to the top of the throat-plate, so bending or breaking it. See that the feed is working properly, and is free from fluff and dust, which often collect in it and choke it up.

Perhaps the needle-bar itself will be found to be bent, this causing the needle to strike on the

inside edge of the hole in the needle-plate. It can be straightened by striking it at its highest point with a light hammer while it is in the machine.

Again, the shuttle, or shuttle race, or both, may be worn, thus allowing the shuttle to fall forward sufficiently to get on the wrong side of the needle —that is to say, the point of the shuttle passes on the outside of the needle instead of the inside. If the needle is adjusted to dip down in the centre of the hole in the needle-plate correctly, and the shuttle can be moved with the fingers enough to strike the needle instead of passing without touching, either a new shuttle must be procured, or enough of the point of the old shuttle, if not badly

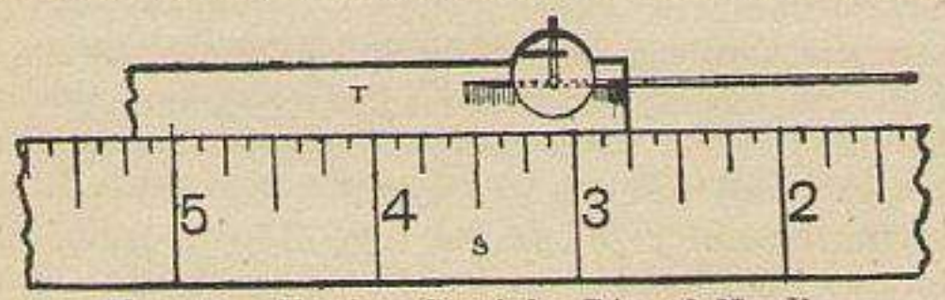


Fig. 53.—Testing Straight Dip of Needle.

worn, must be rubbed off on a piece of emery cloth to allow it to clear the needle.

Other causes of needles breaking are: needle-plate hole too small; edge of needle-plate hole too square (in this case bevel it with emery cloth or countersink it with the point of a drill); needle too small, and so being too weak to withstand the strain; hook too late; shuttle or hook worn; shuttle carrier not guarding needle; roll presser or foot too close to needle; needle-bar set too low. If the hook race is adjustable, see that the hook is not set too close to the needle.

A blunt point will cause breakage, owing to its being unable to pierce tough material, especially at the hems; sharpen blunt needles on an oilstone. The breaking of threads will now be considered.

The causes of the upper thread breaking are:—

(*a*) Needle too small, or thread too large.

(*b*) The needle-plate (throat-plate) hole being too small, or rough or sharp. If the needle-plate has a groove or nitch worn in it on the under side, clean it out, using a strip of emery cloth or a piece of string with powdered emery and oil.

(*c*) The shuttle or hook having sharp edges. The remedy is to smooth them carefully with fine emery cloth. A sharp shuttle will cut the cotton.

(*d*) The shuttle being rough. This causes the thread to catch in passing over it. Smooth it carefully with very fine emery cloth.

(*e*) The shuttle side-spring projecting and catching the cotton. In a Singer machine the cotton may break by catching round the end of the spring nearest the point of the shuttle. To prevent this take out the front centre and spring, which is in the front of the shuttle and which holds in the bobbin, push a piece of wire through the small hole in the front of the shuttle, and stretch the spring; or put in a new spring, if broken, so that the bobbins are held more firmly. If the spring on the outside, called the thread-guide, is loose, solder it on tightly, and smooth with emery cloth.

(*f*) The variable motion not correct, and the timing being faulty. Modern machines keep in time if not interfered with, and the fault becomes apparent generally after taking the machine apart. Interference with the bevel wheels will alter the timing and cause the shuttle to pass at the wrong time. Sometimes, in a Howe machine, the large cams underneath get shifted, and throw the machine out of time; when such a machine is in correct time the needle will be at the bottom of its movement when the shuttle is as far back as it will go, and the needle should start to rise just before the shuttle begins to come forward; to effect this, shift one of the cams until the timing is correct. In the new Crown Howe machine, the above also applies, except that the needle starts to rise and the shuttle to come forward at the same time.

(*g*) The roughness or sharpness of any place through which, or in contact with which, the thread passes. Roughness will hold the thread and sharpness will cut it. Look out for such a fault at the thread-guides. The looper in a Howe chain-stitch machine may get rough and then hold the stitches, so that when the strain increases the thread breaks. In smoothing the looper take care not to alter its shape in the slightest degree.

(*h*) Not enough play for the thread between the shuttle or the driver.

(*i*) The needle being set too high. Setting the needle too high causes the shuttle to jump when it enters the loop, and the cotton breaks owing to insufficient slack thread when the machine works faster than usual. The remedy, is of course, to lower the needle a little. It should be at such a height in the bar that, when the shuttle point is level with the needle, the eye of the shuttle should be $\frac{1}{8}$ in. below the point of the shuttle.

(*j*) The tension being too tight.

(*k*) Common needles with poorly shaped eyes.

(*l*) The needle (in a Singer machine) being set with its long groove against the shuttle.

If the bottom cotton breaks, see that the tension is not too tight, and that the delivery eye-hole in the shuttle is smooth and not cut in. Likely causes are the needle-plate being sharp and the lower thread catching between the needle-plate and casting. Oil the shuttle-race before working, and see that the bobbin is wound regularly.

In buttonhole machines the silk may break for any of the following reasons: In the A style machine (see p. 43)—tensions too loose or too tight; nipper discs too tight or acting too long; take-up spring too heavy; sharpness or notches on the looper or spreaders; needle too high; or an eyelet or thread guide notched. See that the finer silk is underneath. In the B style machines (see p. 44)—sharp parts over which the silk

passes; or tensions too tight. Refer also to causes of missing stitches in buttonhole machines (see p. 81) and see that the finer silk is on top.

Of the various causes of machines working improperly, missing the stitch is the most common. A few of its causes are here enumerated: Bent or imperfect needle; bent needle-bar; needle not set straight in bar; needle striking the side of the presser foot or of the needle-plate; hole in needle-plate too large; needle too large or too small for cotton; not enough pressure on presser foot; take-up spring acting too long; needle set too low or too high; shuttle too fast or too slow in its movement; shuttle point blunt or bad shape; shuttle or hook or roll presser too far from the needle. In some machines the shuttle or hook is

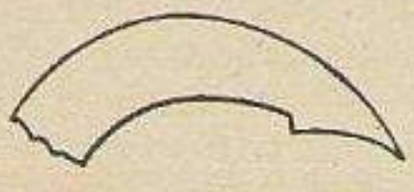


Fig. 54.—Swan-neck Shuttle Point.

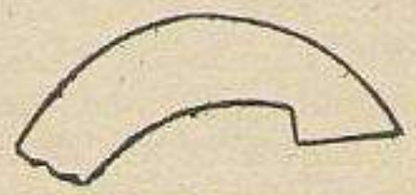


Fig. 55.—Incorrectly Shaped Point.

made adjustable, but when this is so, care must be taken not to set it too close to the needle. When the shuttle is not adjustable in this way, the arm of the machine must be moved. Before doing so, be sure the needle is straight, and the shuttle not worn so as to fall away from the needle; if there is any doubt about it, try a new shuttle.

Much depends upon the shape of the shuttle or hook point. Most shuttles and hooks are made and finished by machinery, and are not all that could be desired as regards working qualities. Very often they are stunted and blunt at the point, and, though they may fit in a machine satisfactorily, are the cause of missing stitches, owing simply to the shape of the point. It is a good plan to make a shuttle point sharp by rubbing it

with emery cloth on its back, not front. Also, if its motion is rotary, hollow it out swan-neck shape, as in Fig. 54, not as in Fig. 55. In the latter case the loop might be pushed on one side or might even slip off the point, but in Fig. 54 when once the loop is on it cannot very well slip off.

Shuttles of the type shown by Fig. 56 have a tendency to wear as indicated by the dotted line A. If the shuttle is worn and a new one cannot be obtained, the old shuttle may be made level by soldering on a thin piece of sheet steel. If the shuttle is worn very badly, a piece of steel may have to be soldered at the heel end B as well as at the point; the shuttle must be well smoothed

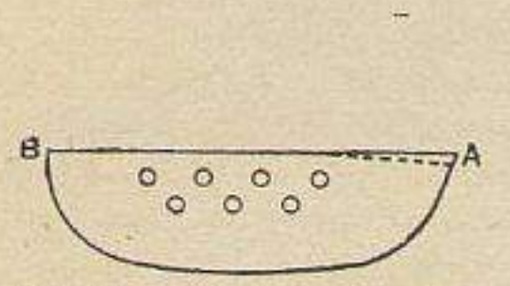


Fig. 56.—Shuttle, Showing Part Subject to Wear.

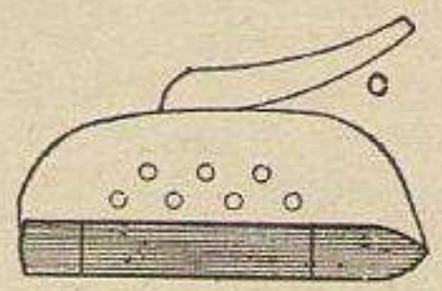


Fig. 57.—Shuttle with Spring.

afterwards and the sharp edges taken off with fine emery cloth. When the shuttle is level on its surface and fits the carrier so that there is not too much end play (by this is meant the amount of space allowed between the shuttle and the carrier wheel, for the proper exit of the cotton), and still the shuttle is observed to fall away from the needle or the loop that has been formed, a slender spring C (Fig. 57) may be made from a piece of old watch mainspring; one end of the spring is to be soldered to the shuttle carrier and the other end allowed to press lightly against the shuttle so as to hold it against the raceway face, but the spring must not press heavily enough to retard the easy passage of the cotton over the shuttle.

A common reason for the thread not catching is that the needle is not properly set. A mark will be found graven on the needle bar near the top. When the needle is set properly this mark should be on a level with the top of the arm while the needle eye is on a level with the needle-plate. The needle should be straight, sharp, and large enough for the cotton. In every style of machine the back of the needle—that is, the short groove—should be toward the shuttle or hook. Also see that the needle dips perpendicularly; if not, remedy as on p. 74. Set the needle up close to the shuttle, if it is not so already, and thread up, and with slides open turn the wheel by hand very slowly, and watch closely the loop thrown out by the needle. The loop should be as shown at L in Fig. 58. In this figure S shows the shuttle, N P the needle-plate, and N the needle. If the loop is faulty, it can be altered by raising or lowering the needle slightly, also by turning it slightly, and by lowering the slack-thread pin P in the top of the needle-bar N B, as in Fig. 59.

When the needle is too high or too low, the hook or shuttle catches the loop at the wrong place, and thus does not really get hold of it.

When a Wheeler and Wilson machine runs all right on thick cloth, but slips stitches in thin stuff, it will be found that there is too much loop; most likely the thread-controller spring in the face-plate of the machine is broken. If this is remedied, and the machine still slips stitches, anything that will control the loop, such as the take-up lever and the height of the needle-bar and needle, must be examined and, if necessary, put right. Turning the needle round a little will sometimes stop slipping, but the main thing is to see that no more loop is thrown out than is just necessary for the point of the hook to enter.

In rectifying a lock-stitch machine, if the machine is threaded up, a piece of cloth put under

the foot, and the machine turned very slowly, it will be possible, perhaps, to see whether the shuttle has any chance to miss the loop which is thrown out by the needle. See, too, that the shuttle passes as close as possible to the needle without actually touching it.

Soaping the seams will often be helpful in preventing missed stitches when thick material is being worked.

A buttonhole machine of the A class (see p. 43) may miss the stitch from any of the following causes: Nipper discs failing to nip the silk tight, or pinching the silk too tight; needle too high or too low; left-hand looper far from or too near the

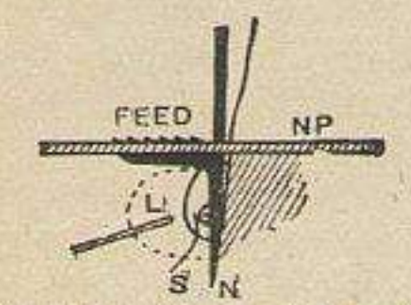


Fig. 58.—Form of Thread Loop.

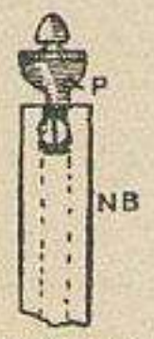


Fig. 59.—Slack-thread Pin in Needle-bar.

needle, or turned upwards too much; the right-hand looper too far from the needle or too early; left-hand or right-hand spreader too soon or too late; under tension too tight; and material spread by clamp too little or too much.

In the B style buttonhole machine (p. 44) the following are causes: Upper needle or under needle too high, too low, or bent; looper too early or too forward in its movement, or too much to the rear of the upper needle; or too late or too far back from the needle (that is, too much on the right hand); upper needle catching on the clamp feet, thus deviating from the perpendicular; hole in button or throat too large; needle-bar or under needle radial block loose; under tension sluggish.

CHAPTER V.

REPAIRING SEWING MACHINES.

PRACTICAL information on repairing sewing machines may be prefaced with the statement that when a broken or defective part has to be replaced, the duplicate should, if possible, be obtained from the maker or his agent. This is far better and cheaper than getting a mechanic to make a new piece, or making it oneself, because in up-to-date factories all parts are machined automatically to shape, and so are bound to fit; and factory goods are cheaper because the processes are much more economical of time and material than are those in use in small shops.

Machines that are used for manufacturing purposes do not often come into the hands of a repairer to be cleaned, because the operators are allowed a certain time each week to attend to this matter. But the domestic machine, which is often allowed to stand idle for weeks and even for months, becomes corroded and stiff, and before it can be used has to be cleaned. Sometimes a free application of paraffin to all parts and a wipe over with a duster will sufficiently clean the machine so that after lubrication it can be worked easily. If this does not suffice, strip the machine of all fittings, taking care to mark any parts which may be difficult for an inexperienced person to replace, so that they may be put in again in their original positions; place all bright parts (not japanned) in water, adding a good quantity of soda, boil them until quite clean, and wipe briskly with a clean wiper, afterwards polishing them carefully with emery cloth, being sure to wipe off all emery dust before replacing the parts in the machine. The shaft bearings, etc., may be scraped with a scraper, or carefully cleaned out with emery cloth, but if emery is used be sure to wash out the bearings with paraffin, otherwise the emery dust will soon destroy the surfaces of the bearing.

Two kinds of scrapers are mostly used—triangular and flat. These can be easily made from triangular and flat files by grinding them smooth. The triangular file may be ground slanting at the point, and is a handy tool for scraping and trueing the grooves in cams, cleaning out bearings, etc. The flat file may be ground at the end like a chisel, and is handy for removing dirt and corrosive matter.

In taking a machine to pieces, method and order will be of great benefit. Notice carefully the whole construction, and begin to take a machine to pieces by removing the face-plate, and then the side of the arm or back-plate. Next take particular notice of the position of the cams and gear wheels, marking each in a way that will be well known and easily recognised. If the cams, wheels, and gears are fastened in position by means of pins, find the large ends of the same and mark the cam or wheel near to that end, so that it will show both the time of the part and the right way of driving in the pin.

Some cams and wheels are held in position by two screws, one a set-screw, the other a spot-screw; that is a screw with a long tail that enters a hole in the shaft, in this way keeping the part in right time. When such is the case, find out (by removing each screw separately) which is the spot-screw, and remove that entirely, but leave the set-screw loosely in the other hole; then there will be no difficulty in replacing the cam or wheel.

When parts are pinned in position, care should be taken in driving out the pins, which are generally taper. For this purpose, a taper punch should be made out of cast steel and tempered

down to dark straw colour. Having obtained a punch the right size, turn the part until the small end of the pin is uppermost and give it a sharp, firm blow with a hammer. Do not give three or four taps at a pin, or the result will be to burr the pin over and make it necessary to drill it out. Keep each pin to its own part. When gears and other parts require driving out, use a brass punch or drift, so as to prevent damaging the part. Scrape away any oil or dirt that prevents a part being removed fairly easily.

To reassemble a machine, always begin with the needle and needle-plate. Use a perfect needle, see that it enters the centre of the hole in the needle-plate, and if it does not, reset the arm of the machine. When this is right, fix the shafts, cams, etc., in position, and try each movable part as it is fitted to see that it moves freely. If too loose, refit it, or replace it by a new part.

Feed wheels occasionally work irregularly—that is, make long and short stitches and occasionally stand quite still. The action is somewhat complicated, and there are many causes for irregular feeding. However, in fitting feed wheels, see that they run perfectly free, and yet have no perceivable play. A tight feed wheel puts extra strain on its driver and leaves no exit for dirt.

Worn feed wheels may be recut. To do this, place them in a vice and use a triangular file or a half-round file with a flat ground on it. If the wheel is worn badly and requires levelling and grooving, place it in a lathe, file it level, and make a fine grooving tool out of a 4-in. flat file and groove the wheel carefully. Do not let it revolve too quickly. When filing the teeth, cut all the rows to the same depth.

For removing the shaft or main spindle from a Singer machine, first take out the gear pin and put in a punch or something similar and take off the wheel by unscrewing the screw, letting the

punch hold the shaft while the wheel is turned from the operator, the screw being a left-handed one. The shaft can then be slipped up sufficiently to get out the pin in the cam wheel, and the shaft can be driven out of the wheel end of the arm.

To take out the play in the shaft bearing of a Singer I.F. machine without fitting a new bushing, proceed as follows: At the rear of the machine arm casting, near to the hand wheel, will be found a small set-screw which holds the shaft bushing in position; remove this and the hand wheel, then drive out the bush, using a long steel punch or drift. Place the bush in a vice, and with a hack saw cut it through lengthways at the top, as in Fig. 60. Clean off any sharpness from the inside

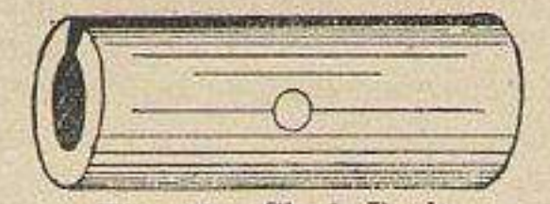


Fig. 60.—Shaft Bush.

of the bush, and replace it in the arm of the machine, keeping the split part uppermost. The small set-screw, when replaced, acts as an adjusting screw. Care should be taken not to tighten this screw so as to cause the shaft to bind in the bush.

Some makes of shaft can be placed in a machine without any fitting, the machinery used producing interchangeable parts. In some machines, however, manufacturers purposely make certain parts (particularly shafts and studs) a little large to allow for probable wear in the bearings, etc., in which they work. In such a case do not enlarge the bearing by filing it, but instead, reduce the shaft, and be sure that the bearing is free from dirt, oil, or emery when fitting a new shaft. Place the shaft between the centres of a lathe, and with a smooth file reduce the shaft until it fits tightly

in its bearings; afterwards thoroughly polish with F emery cloth until all traces of file marks are obliterated. If, after polishing with emery, the shaft still fits tightly in its bearings, repeat the polishing until the shaft binds only slightly. The shaft is then run in with rottenstone and oil, and the bearings are afterwards thoroughly cleansed with paraffin. The dulness that is the unavoidable result of grinding in can be removed by again placing the shaft between the lathe centres and polishing with a piece of worn OO emery cloth. (Blue-back emery cloth is the best, as it is much stronger than white-back.)

Shafts for high speed sewing machines are sometimes made and fitted in the manner described below. Suppose the shaft is $\frac{1}{2}$ in. in diameter; the bearings are first bored out $\frac{1}{2}$ in. in size, then finished with a reamer $\frac{3}{1000}$ in. larger, which gives clearance for lubricating. Shafts are turned a little larger than required (then hardened), and are finally ground to the exact size in a lathe with a grinding device. For instance, a shaft finished $\frac{1}{2}$ in. in diameter would have its bearings $\frac{3}{1000}$ in. larger. Should there be any variation in the size of shaft or bearing that would cause binding, place the shaft between the lathe centres, and reduce at places where the shaft binds, using fine emery cloth; but this procedure is seldom necessary. If one bearing is in the form of a loose bushing, care must be exercised in driving in this bushing. Should any deviation cause the shaft to bind, a slight blow with a mallet or hammer shaft on the projecting shaft end will generally liberate the bushing; afterwards tighten the bearing set-screw. First test the loose bushing on the shaft, in order to ascertain whether the fit is perfect.

Some machines have an upper and a lower shaft which are coupled together with a shaft connection. These connections in course of time get worn and require fitting, as their play causes defective action

to certain parts. The best way is to take off the shaft and connections, but before removing the connections put a mark with a half-round file across the side of the connection cap, so that it can be replaced in the right position easily. Having taken out these parts, place the connection in a vice and file off a little carefully; do this until the connection, when screwed up quite firmly, just grips the shaft. Next place the shaft in a lathe, between the centres, and grind it into the connection with fine emery powder and oil, letting the shaft revolve whilst the connection is held firmly. Wash off all powder with paraffin oil. When each connection has been treated in this way, reassemble the machine, and run it for a short time on a stand or bench-jack until it is quite free.

Some machines are constructed with one horizontal shaft and one vertical shaft, each connected with a pair of gear wheels. These become worn and sometimes broken, and have to be replaced, a task that requires method, for the time of the needle with relation to the shuttle depends upon the way in which these gears are held in position. If both gears are broken, to fit a new pair keep to the following instructions: Remove the face-plate, then the side of the arm, and then turn the hand-wheel until the large end of the taper pin in the gear is uppermost. (1) With a centre-punch mark the gear in line with the centre of the pin-hole; (2) then place another centre dot on the shaft, in line with the one on the gear; (3) take a pair of dividers or compasses, and measure the distance from the centre dot on the shaft to the centre of the pin-hole, not to the dot on the gear, which is simply a guide to the large end of the pin. (4) Next make a centre dot on the centre of the large end of the pin in the corresponding gear wheel; (5) insert the point of the compasses and scribe a line on the shaft; (6) make a centre dot in line with the one on the pin head; and (7) place the compasses in a

safe place, so that they cannot be altered, and take the machine apart, removing everything. Then fit new gears to each shaft. If the shaft is too large, reduce it by filing in a lathe.

Having fitted each gear satisfactorily, reassemble the machine without connecting the gear wheels; that is, without placing them in gear. Put the shuttle and needle in, turn the machine edgeways, with the gear wheels uppermost, and fix it in a vice. Then proceed as follows: Place the shuttle carrier as far back as it will go, and in such a position that it is just about to move towards the needle; then turn the hand-wheel in its proper direction until the needle descends to its lowest point of travel, and continue until the needle has arisen about $\frac{1}{64}$ in., but never more than $\frac{1}{32}$ in.; then slide the gears together and fasten them with set-screws, the gears being drilled and tapped for this purpose. Next turn the hand-wheel and notice that the gears neither bind nor are too loosely connected; then examine the time of the needle-bar with the shuttle. The needle-bar should have about $\frac{1}{64}$ in. start of the shuttle.

If this is correct, proceed to mark the gears ready for drilling in this way: Take the compasses, putting one point in the centre dot on the shaft, with the other marking a line on the gear-wheel; then insert the centre dot exactly parallel to the one on the shaft, doing the same to the other gear-wheel. Then take up the old gear-wheel and find a drill the same size as the small hole, and with a hand drilling machine drill each gear-wheel. If these directions are carried out, the drill will pass through the hole in the shaft and the new gear-wheels will be in the same position as the old ones. After drilling, with a taper reamer make holes the right size for the pins. When the use of a vertical drilling machine is possible, it is certainly advisable, and a wooden jack may be made to support the sewing machine whilst being drilled.

The above method of marking will be useful for fitting new cams, discs, and other parts that require drilling and pinning in position. If the gear-wheels make a noise, grind them with fine emery powder and oil, or, to prevent noise, insert a piece of brown paper between the gears when connecting them.

The following hints on fitting a new take-up cam apply to more modern machines, as the old style take-up lever is actuated generally by the needle-bar; but in machines having a rotary or reciprocating shuttle the take-up lever has a varied motion made by a grooved cam. These cams, if of cast-iron, are liable to become worn very much in one place, hence the need for a new cam. Some cams are held in position by spot-screws, and are therefore easily replaced, care being only required to put the spot-screw in the right hole; other cams are held in position by means of taper pins. First take out the parts necessary to remove the old cam; place a mark on the shaft to indicate the large end of the pin; fit the cam on the shaft (not too easily), replace the other fittings, and prepare for timing the machine. When the action of the shuttle is oscillating, put the shuttle carrier at its most backward position—where it is just about to move towards the needle; then place the take-up cam so that the needle-bar rises slightly (not more than $\frac{1}{32}$ in.), secure it with a set-screw, and ream out the hole to fit the pin.

The hole is generally drilled in the cam at about the right position, and simply needs reaming out, but in some cases the holes in the cam and shaft may not correspond. In such a case remove the cam and shaft, plug up the shaft-hole with a piece of steel wire, braze it, and then clean it off, replace it in the machine, set the cam as already instructed, and drill it in this position.

With a rotary hook, allow the needle-bar to rise from $\frac{3}{32}$ in. to $\frac{1}{8}$ in., bring the hook point to the needle, and secure the cam in this position.

The Singer oscillating shuttle machine is one of the most universal of the modern types of machines, and is fast superseding the older styles, as it combines lightness with speed, and makes a good stitch on all classes of work. The part most liable to get out of order in these machines is the shuttle, of which there are two kinds, as illustrated by Figs. 61 to 63; that shown by Fig. 61 is the older, and is liable to get out of order sooner than that shown by Fig. 63.

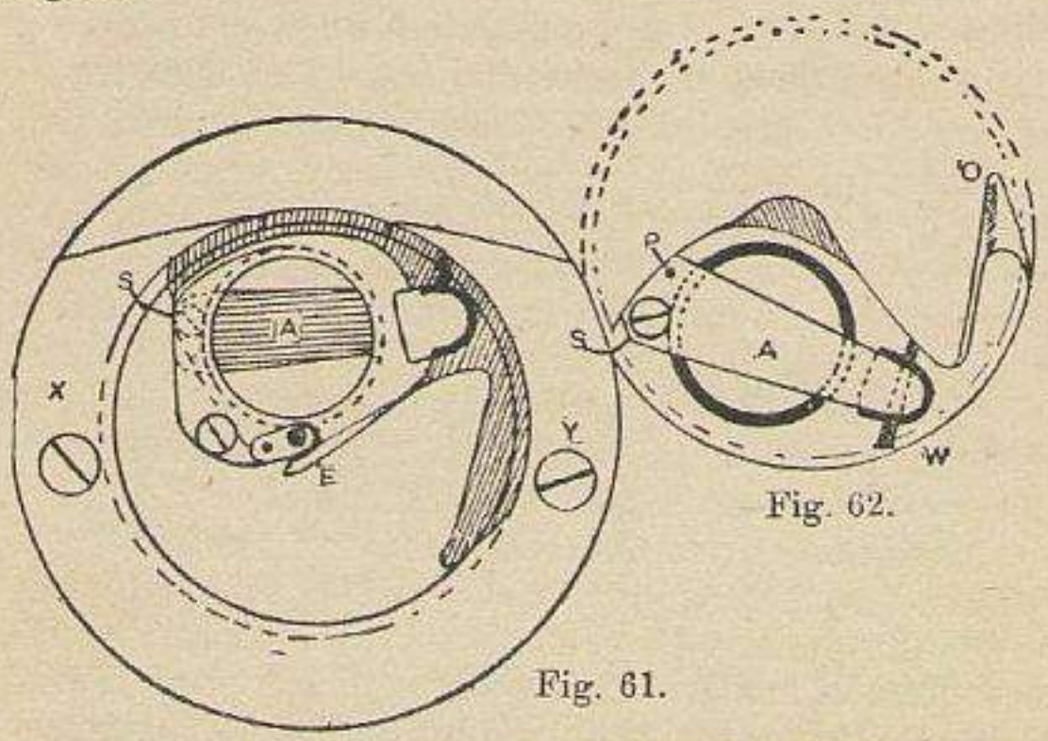


Fig. 62.

Fig. 61.

Figs. 61 and 62.—Front and Back Views of Shuttle in Ring.

A frequent breakage in an oscillating shuttle is that of the mainspring A (Fig. 61). This spring, which is fastened by a screw S and pin P (see Fig. 62), may be easily replaced; care should be taken, when replacing it, that the end at S is dressed off level with the edge of the shuttle. In putting on the spring it is advisable to take the shuttle apart by knocking out the pin at W (Fig. 62), and striking the end with a hammer and small punch.

If the tensions of the oscillating shuttle get out of order, it is easiest to put in new springs or screws, as required. These springs are fastened by

a screw R inside the shuttle, as shown by Fig. 64, and both springs and screws can be procured at any of the Singer Company's depôts.

If an oscillating shuttle has had a lot of wear, and rattles in its race, it is better to replace it by a new one; but if it rattles, and yet does not seem to be much worn, it may be because the ring X Y (Fig. 61) is worn. If so, file the inside flat with a broad, smooth, flat file until all the marks of wear are taken out, holding the ring in one hand while filing. Never tighten up a race to fit an old shuttle; if the race must be tightened, fit a new shuttle in

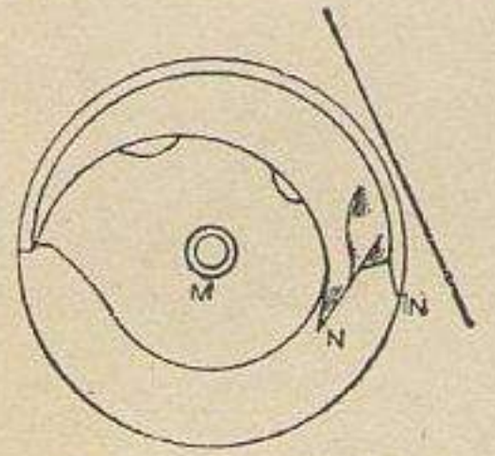


Fig. 63.—Newer Type of Shuttle.

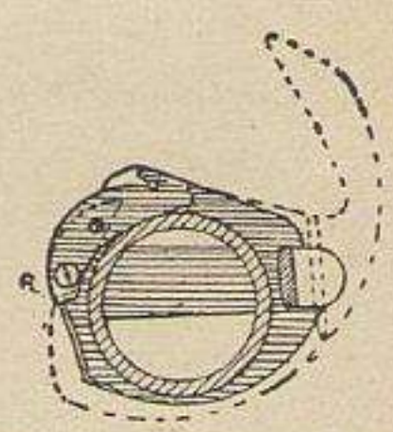


Fig. 64.—Separate View of Shuttle.

it, and afterwards take it out and work with the old one, if the latter is not too much worn.

The thread delivery eye E (Fig. 61) of an oscillating shuttle is liable to get cut in with wear, and can be easily replaced. It is fixed with a small pin, riveted at each end. Care must be taken to smooth the outside riveted end well, or it will break the top cotton in working. Do not interfere with the shape of point O (see Fig. 62), which is extremely hard, and will snap off if roughly used.

The oscillating shuttle illustrated by Fig. 63 is of a recent type, and is not liable to get much out of order in itself, unless the points N N should become broken off. If the shuttle is a solid one, it cannot be repaired, so must be replaced; but if

it is one of the older sort, as Fig. 65, it can be taken to pieces by removing screws A A, and replacing the worn or broken part or parts.

The spool case (Fig. 66) of an oscillating shuttle contains the spool, and slips over the pin M in the shuttle (Figs. 63 and 65). If the tension does not act properly, take off the spring and remove the screws; if the parts are worn, replace them with new ones. If the position finger F (Fig. 66) gets loose, rivet up the pins at V V, or put in new pins and run in a little solder by a blowpipe. If the position finger gets bent out of shape, it must be straightened again, or it will smash the needles.

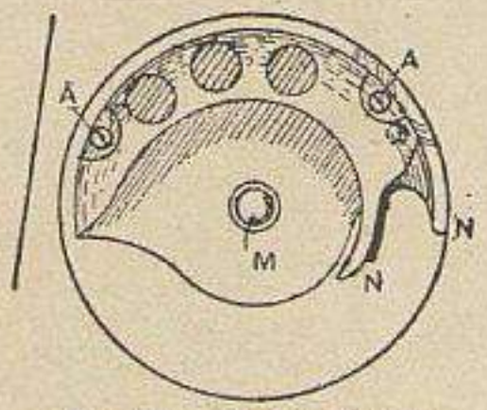


Fig. 65.—Solid Shuttle.

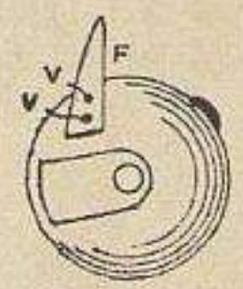


Fig. 66.—Spool Case.

When in place it should just catch in the slot in the shuttle race, without slipping out again.

An oscillating shuttle race requires tightening only when the new shuttle has too much side play in it. To take out the race, loosen the two screws that hold it to the bed of the machine—that is, if the machine has a loose race. Some of the older machines have the race cast on the bed, and a new shuttle should fit these races sufficiently tight. If it does require tightening, probably the outside ring, which comes off when taking out the shuttle, can be smoothed up again on a sheet of emery cloth, placed flat on the table or bench top. With a loose race machine, pack the race carefully with emery cloth; this will save softening the race. It is not often necessary to tighten races. When

the shuttle is replaced in the machine, see that it passes the needle without catching it. If it catches, with emery cloth take a very little off the point where it touches the needle.

The Singer reciprocating shuttle machine shown by Fig. 67 (see also pp. 28 to 32) is largely used for

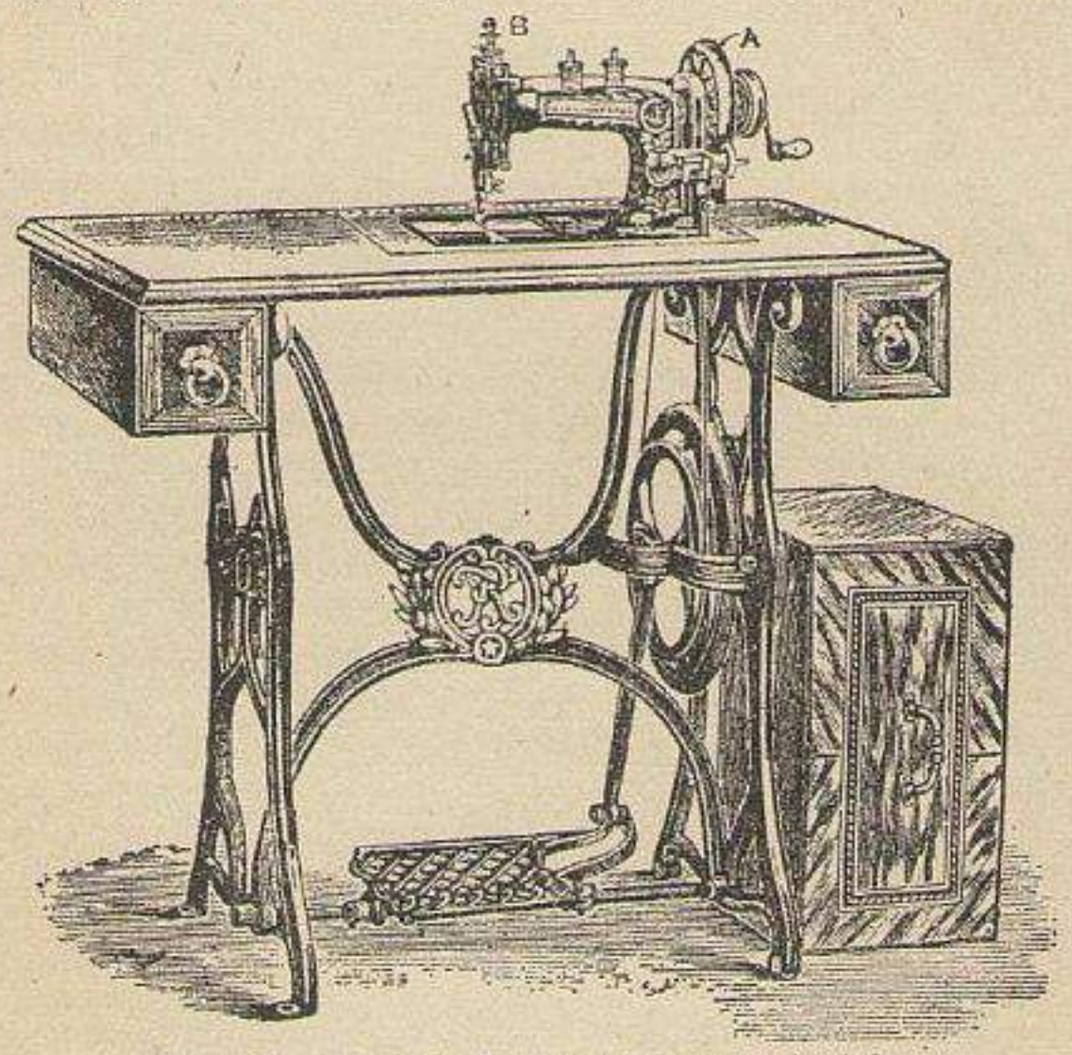


Fig. 67.—Machine built on Singer Principle.

domestic work, as well as by dressmakers. Since the lapse of the Singer patents, this class of machine is made by many firms; thus a general explanation of the repair and adjustment of the Singer machine will be applicable to other machines built on the same principle. The machine illustrated by Fig. 67 is made by Messrs. Frister and Rossman.

The "Family" machine, as its name indicates, is intended for domestic or family use.

The "Medium" is more strongly built, has more space under the arm, a longer needle, and is used for stitching a heavier class of goods, such as mantles, and for tailoring. The machine consists chiefly of an iron bed-plate, to which is attached, by means of large screws, a cast-iron arm. In some machines two dowel pins also are inserted to prevent the moving of the arm, which is likely to happen during transit.

The shuttle-race in the "Family" machine forms part of the bed-plate casting, whilst in the "Medium" the shuttle raceway is part of the casting, with the addition of a movable steel bar, which is held in position with two screws and two dowel pins. The reason for this difference is that the gears in the "Family" machine are of cast-iron, whilst in the "Medium" type they are of wrought-iron or steel. Should the shuttle of a "Family" machine become jammed in the carrier or shuttle raceway (which is quite likely if the shuttle slide be left open), the teeth of the gears usually break; but in the "Medium" the gears, being of wrought-iron, are better able to stand the strain, and the raceway, if composed entirely of cast-iron, would probably give way and break; hence a steel bar is made to form part of the raceway, so that in the event of a strain it may be repaired or replaced.

When repairing machines with cast-iron raceways, if the gears are broken, replace with gears of cast-iron, not wrought-iron.

In the arm of the machine is a horizontal upper shaft and a vertical lower shaft; the former gives motion to the needle, the latter to the shuttle. When removing these shafts, as will be necessary when thoroughly cleaning or when fitting new gears, first mark the gears and shafts with a centre punch in such a way as will ensure their correct replacement; then remove the face-plate by taking out the two set-screws, and drive out

the taper pin from the upper gear-wheel. Next remove the hand-wheel A (Fig. 67). If pinned through the boss, take out the pin, and with a large centre-punch and hammer, drive the shaft to the left until the hand-wheel can be drawn off.

If the machine has a stop-motion or triple-action device, proceed to take off the wheel as follows: With the left hand place a block of iron about 1½ in. by ½ in. by ½ in. inside the face-plate end of the machine arm, so that the cam roller will lodge on it firmly; then with the right hand turn the hand-wheel sharply towards the back of the machine, until the stop-motion screw (which is threaded left hand) falls out. The hand-wheel can then be withdrawn.

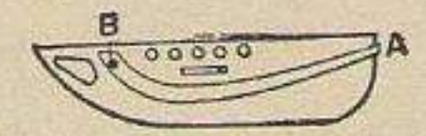


Fig. 68.—Boat-shape Shuttle

Next take off the needle-bar driving disc. To do this, drive the shaft to the left, keeping the small end of the taper pin uppermost. Place the edge of the disc on the bench or vice, so that it may have a firm bearing, and drive out the taper pin. Drive the shaft back to the right, place the machine endwise on the bench—that is, with the face-plate end to the bench—and drive the gear-wheel towards that end as far as the casting will allow; then place a centre punch on the shaft at the disc end, and with a hammer drive out the shaft.

To remove the lower vertical shaft, drive out the pins in the gear-wheel and collar, place a strong punch at the upper end of the shaft, and with a hammer drive the shaft downwards. Before taking out the vertical shaft remove the shuttle carrier connecting-rod, which is held in position with two small pins and washers. Also remove the feed and stitch regulating parts.

The shuttle (Fig. 68) is of boat-shape design. The bobbin is held rigid by means of a centre and spring, which is fitted in a recess at the nose end. These springs often become weakened, while sometimes they break. In each case they should be replaced with new ones; the old centre can be easily taken out by forcing a needle or hairpin through the hole near the point of the shuttle.

The side-spring A (Fig. 68), if worn or broken, may be replaced in the following manner: Drive out the pin B and remove the old spring. Make a small pin out of fine iron wire, or use an ordinary brass pin, and place it through the hole in the side of the shuttle, having the head of the pin inside

Fig. 69.—Edge View of Shuttle Carrier.

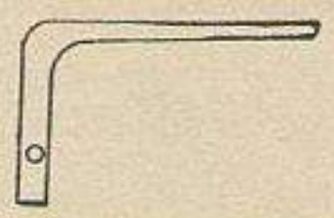


Fig. 70.—Shuttle Carrier Spring.

the shuttle. Place on the spring, and rivet over the pin neatly. If a small anvil is not available, this may be accomplished by placing a hammer in a vice and resting the inside of the shuttle upon it, using another hammer for riveting. Having secured the spring, well solder around the pin end, and finish smoothly with fine emery cloth. Any sharpness or roughness upon the shuttle is likely to cause the cotton to break.

The hooked end of the shuttle carrier (see the edge view, Fig. 69) fits in the recess on the shuttle nose, and sometimes becomes strained upwards, allowing the shuttle too much freedom, which might cause "miss-stitch." When this happens, hammer it into its correct position, care being taken not to force it too low or to bend it inwards as indicated by the arrow (Fig. 69), for by so doing the cotton might be trapped and broken.

Sufficient space between the heel of the shuttle and carrier should be allowed for the free passage of the cotton. If there is too much play, and it cannot conveniently be taken out, fit a new shuttle or carrier, or both. All sharpness or roughness should be removed from hook and heel ends of the shuttle carrier, to prevent the breaking of the upper cotton.

The spring (Fig. 70) is held in position on the shuttle carrier with a screw. Its function is to keep the shuttle up to the face of the raceway, or, in other words, to prevent it rocking away from the needle. When set too hard upon the shuttle, the freedom of the cotton is impeded; when set too far off, the shuttle may fall away from the

Fig. 71.—Take-up Lever.

Fig. 72.—Check Spring.

needle, and thus miss the loop, causing a miss-stitch.

The slack thread take-up lever illustrated by Fig. 71 is held in position with a long screw on the front side of the arm near the face-plate. It is actuated by the movement of the needle-bar, and is held rigid with a spring (Fig. 72). This spring sometimes gets broken; consequently, the action of the lever is thwarted, and the cotton remains in loops on the under side of the material. When such is the case, replace with a new spring, the pressure of which may be regulated with the small holes in the side of the arm.

To fix a new spring, first remove the long screw, and draw out the lever; then force the old spring out by means of a small screwdriver. Insert the new spring, keeping the hooked part downwards, and place the take-up lever back again, so that it rests in the hook of the spring. Put in the long screw a little way, and turn round the long end of

the spring until it can be pushed into one of the holes before mentioned; then firmly tighten the long screw. The hole in the end of the lever should be smooth, to prevent any chafing of the cotton as it passes through.

The action of the lever can be regulated by the slack thread pin B (Fig. 67, p. 93). Sometimes it is held in position with a small screw at the side of the needle-bar; sometimes it is screwed into the needle-bar (see Fig. 73), and held firmly by a lock-nut; and it should be so regulated as to begin its downward movement when the needle-point has entered two thicknesses of calico.

It is of the greatest importance that the needle-bars fit perfectly, as any sideplay may cause trouble. Slackness of the bar up or down, caused by a worn-out roller and stud, or heart-cam, would also be a source of trouble, and new parts should be fitted. This would only happen after much wear, or as a result of neglect in oiling the parts.

In taking play or looseness out of a needle-bar, remember that some needle-bars are four-sided and bevelled, others are round. It is not always necessary to fit a new needle-bar; in fact, the life of a needle-bar may be years. When bevelled bars become loose, file a little off the inside of the face-plate and carefully refit, making all quite smooth with emery cloth; this also applies to round bars in the old type of machine. Round bars in new style machines are usually packed with felt washers or string, and have an oil-cup screwed into the upper and lower bearings. When one of these bars becomes loose, take out the oil-cups and re-pack with string; then screw in the oil-cup until the needle-bar is firm, and well oil it.

It is a common complaint that in this type of machine the needle becomes untrue in the bar. Fig. 73 also shows a truing gauge, which can be made out of $\frac{1}{16}$ in. sheet steel, and should be 5 in. or 6 in. long. It must be perfectly true on one

edge, and hollowed to admit the needle clamp. A 6-in. straightedge rule, hollowed as described makes a splendid gauge. Place this gauge alternately on two sides of the needle-bar, and the slightest variation in the truth of the needle will be apparent. Of course, a perfectly straight needle is necessary for testing purposes, and it is

Fig. 74.

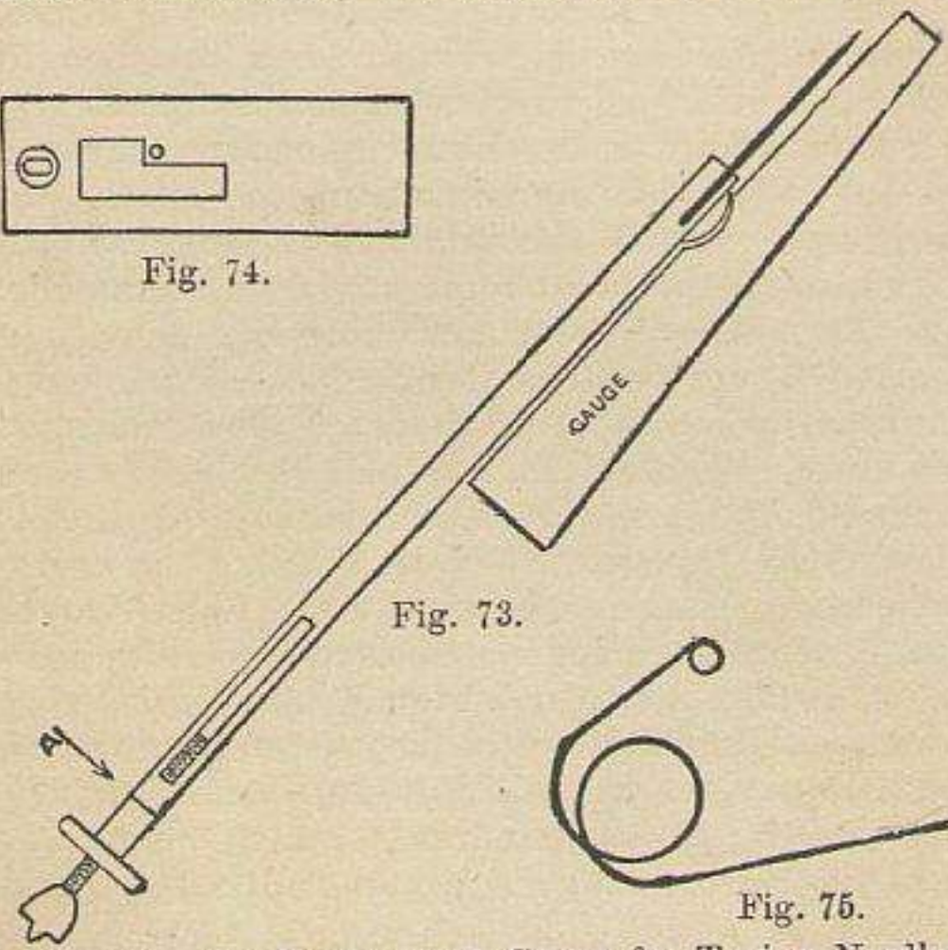


Fig. 73.

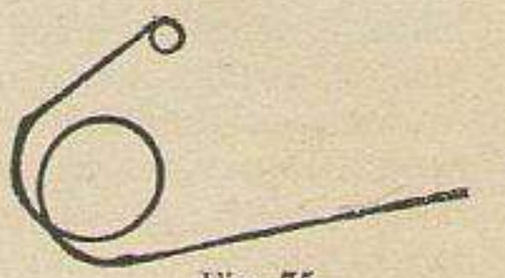


Fig. 75.

Fig. 73.—Needle-bar, with Gauge for Truing Needles.
Fig. 74.—Needle-plate. Fig. 75.—Feed Spring.

advisable to set the needle to the correct height in the bar.

To set the needles in this class of machine, proceed as follows: Allow the needle-bar to descend until the mark A (Fig. 73) is level with the top of the face-plate, then set the needle so that the eye is level with the top side of the needle-plate. There is a possibility of the mark on the needle-bar being wrong. In such a case, the needle must be set so that the shuttle catches

the loop properly; then another mark should be filed upon the needle-bar. When a needle sets out of line, remove the needle and needle-clamp from the bar, and with a fine square file true very carefully the recessed part of the bar, testing frequently with the gauge until it sets perfectly true.

When needles set imperfectly, either breaking of needles or missing of stitches may be complained of. If the needle inclines towards the shuttle, there is a tendency to break needles; if it leans away from the shuttle, the tendency is to miss the stitch. If the deviation is to either side, the operator would find it difficult to guide the material straight, the needle having a tendency to move the material in a zigzag form.

Fig. 74 represents a needle-plate, or, as it is sometimes called, a "throat-plate," the position of which is very important. It will be observed that the screw-hole A is slotted, thus allowing the adjustment of the plate to be either forward or backward. If the needle-plate is fixed too far back, it gives the needle a chance to strike on the shuttle, causing it to become blunt-pointed or broken. If the needle-plate is set too forward, the needle is pushed away from the shuttle, causing miss-stitches; or the cotton becomes chafed between the needle and the plate, and is thus made to break.

The correct way to set a needle-plate is to give the needle sufficient room for the freedom of the cotton, and yet not so much as to allow the needle to strike the shuttle. For very fine needles, fine needle-plates should be used; medium- and coarse-hole needle-plates are suitable only for medium and heavy materials.

When adjusting the needle-plate, first observe the position of the needle with relation to the slot in the raceway. The needle should set, when perfectly true, just inside the slot. If too far in the slot, the needle will be too far from the shuttle

and may miss the stitch; if it sets out of the slot, the shuttle will break the needle. Sometimes this can be adjusted by loosening the face-plate screws and pushing the face-plate until the needle is set correctly, the holes in the face-plate being large enough to allow for this. When unable to adjust in this way, reset the arm upon the bed-plate, and afterwards firmly tighten all screws that have been loosened. Sometimes this has to be done after retruing a needle in a badly worn needle-bar.

The length of stitch is regulated with a thumb-screw at the right end of the bed-plate. By loosening this screw and moving it along the slot to the right, the length of the stitch is increased; by moving it to the left, the length is reduced. Be sure to retighten the screw firmly.

The feed in this class of machine derives its action from a cam attached to the back of the shuttle driving crank, which is on the under side of the machine. This double cam acts upon a long lever, which moves in a recess in the feed itself. To this lever is fitted a wedge-shaped slide, the thick part of which, when in contact with the feed, raises it above the needle-plate; it is lowered by means of the thin part of the wedge. The feed is held firmly against this wedge by means of a spring (Fig. 75), which is screwed to the under side of the bed-plate, the long end fitting into a small hole in the feed. These springs sometimes break, or slip out of the feed-hole, and the proper feeding action gets impeded. A new spring can be easily replaced by taking out the small set-screw. The feed may be raised or lowered by moving the wedge-shaped slide to the right or left. In some machines the end of the feed lever is made wedge-shaped, the feed rising and falling by this wedge coming in contact with another wedge-shaped block. In each case the method of adjustment is the same; the block in the latter case, however, being movable to the right or left.

This concludes the description of the methods in common use for repairing Singer-type machines.

The repairer may occasionally have to fit a shuttle carrier to an old Howe oscillating or vibrating shuttle machine. There are two kinds of shuttles used in the Howe type of sewing machine, the plain, boat-shaped shuttle and the hooked shuttle. The boat-shaped shuttle (Fig. 76) lies in the shuttle carrier as in a cradle, and is driven to and fro by the heel and two front prongs A and B. The carrier is fastened to the carrier lever D by

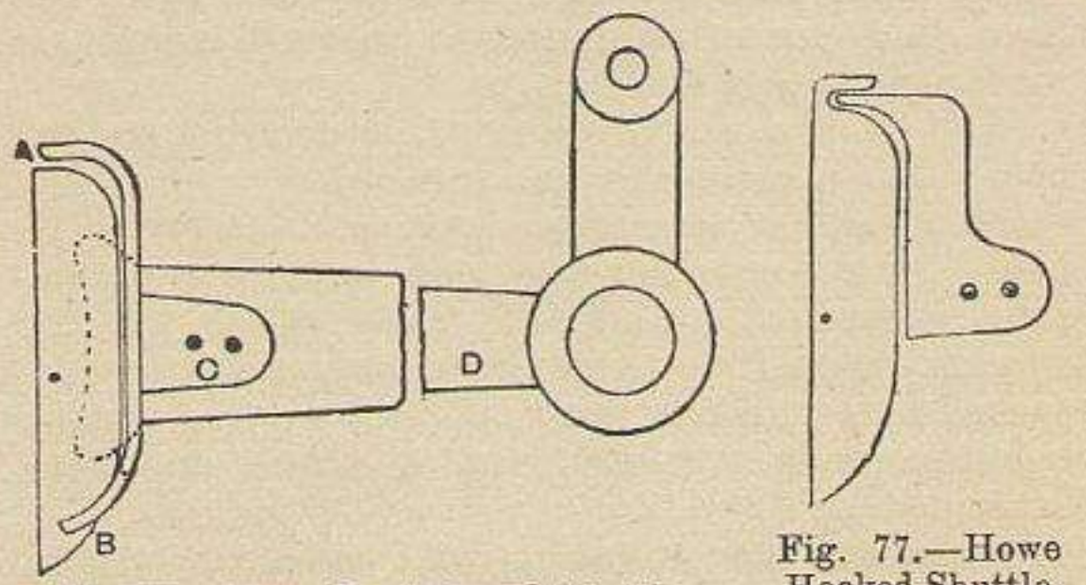


Fig. 76.—Howe Boat-shaped Shuttle in Carrier.

Fig. 77.—Howe Hooked Shuttle.

two small screws, the screw holes in the lever being slotted so that the side play between the shuttle and carrier may be adjusted by moving the carrier to the left or right. The end of the carrier lever, as indicated by the dotted lines, forms the bed of the carrier on which the shuttle rests.

This carrier can easily be made from flat spring steel, $\frac{5}{8}$ in. by $\frac{3}{16}$ in., bent at each end and filed out to form the prongs. Sufficient clearance for the thread must be allowed at the heel and prongs A and B (Fig. 76). An angle piece C, with two tapped holes about $\frac{1}{8}$ in. in diameter, can be made from the same sized steel; it should be fastened

to the carrier body by two rivets, and afterwards brazed securely, but great care must be taken to fasten the carrier in such a position as to allow the shuttle to fall sufficiently to the rear of the needle that a bold loop may be formed. The heel of the carrier should also be well rounded from the under side upwards, so that the loop, when it is being drawn off, will not hang on the heel of the carrier and break. Thoroughly smooth the entire carrier, especially the points A and B, with fine emery cloth. The heel and front prongs may be hardened when in working order. Do not leave them too hard; have them tempered so that they can just be touched by a file.

The hooked shuttle (Fig. 77) is driven from the heel. The shuttle moves in a raceway recessed the correct shape to prevent it rocking sideways. The heel of the carrier must be very smooth, and sufficient clearance given for the freedom of the thread. Sometimes this form of carrier is connected to the driving lever by a link and two studs, but this does not alter the principle as above described.

Some notes on repairing and adjusting heavily built machines for leather work, etc., will now be given.

A Bradbury arm patching machine is put in time in the following way: When the needle-bar has just reached its lowest point (for the first time, as it dips twice and then rises right up to the top of its stroke) the shuttle should be at rest as far back as the rack and pinion will take it, as shown by Fig. 78, in which A indicates the position of the needle at its lowest point. The needle should rise a little before the shuttle moves, and after the shuttle has picked up the loop of the thread, the needle drops again, to allow plenty of time for the thread to pass over the shuttle, and then the needle rises to its full height and pulls up the slack thread (with the check lever),

and the stitch is formed. See that the needle is set at its proper height by the mark in the needle-bar.

Irregularity in the length of stitches when using wax-thread in a leather-stitching machine may be caused by the feed being too low or the teeth not sharp enough. For wax-thread work the feed should be at least $\frac{1}{32}$ in. above the needle-plate when the needle-bar is at its highest point. If too low, dovetail and braze a piece on the under side and file it until the required height is obtained. If the teeth are worn smooth, soften the feed in the usual way and recut with a three-square file.

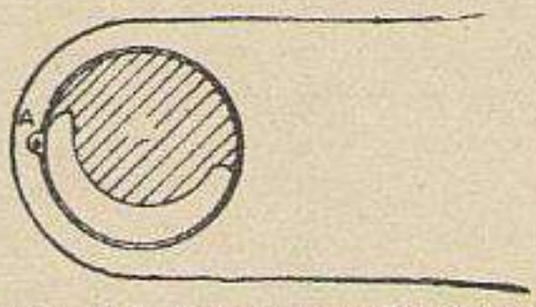


Fig. 78.—Shuttle, etc., of Arm Patching Machine.

Another cause of irregular stitching may be the general looseness of all the feed and stitch regulating parts. To test this, turn the wheel of the machine until the needle-bar is at about its highest point of travel and the feed about to move to make the stitch, then with the thumb and finger try to move the feed backwards and forwards; if by so doing much movement is obtained, it will be obvious that some parts are worn and must be refitted or replaced by new ones.

Singer boot-repairing machines, when sent out, are usually adjusted to work threads up to No. 25, three-cord wax-thread, for which No. 6 special wax-thread needles should be used. They have to be altered if a larger wax-thread is to be used. For instance, to use No. 18, five-cord wax-thread, the following alterations will be necessary. Fit

a needle-plate having a larger hole than usual, or have the needle hole in the needle-plate now in use drilled larger (see Fig. 79, which shows the needle-plate from the under side). Also see that the under side A of the needle-plate is milled deep enough to allow the thread to pass freely over the shuttle; and make sufficient thread passage between the shuttle and the shuttle carrier by filing the heel of the carrier (see B, Fig. 80). Be sure to smooth this part with emery cloth after filing it. Use a No. 8 or No. 10 needle, according to the substance to be stitched, and if the machine has been in use a long time, remove all nitches that have been made by the finer threads in the

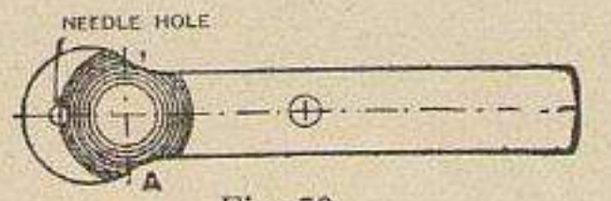


Fig. 79.

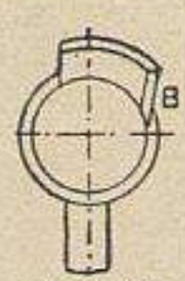


Fig. 80.

Figs. 79 and 80.—Adjusting Singer Repairing Machine.

guides, etc, or these will have a tendency to chafe the coarse thread.

The shuttle carrier being out of position may be the cause of a shoemaker's machine with horizontally working shuttle failing to make stitches, and instead, entangling the looped thread with the shuttle. The shuttle does not come far enough round to cast the loop. The heel at the time the loop is drawn off should be stationed almost directly beneath the hole in the needle-plate to permit a clearance for the exit of thread. The remedy is to proceed as follows: First remove the machine head from the stand by taking out the four screws (one to each leg) which secure it. Remove the needle-plate and then lay the machine head sideways on a bench or table, and take off the small plate from the under side of the machine

bed directly beneath the shuttle carrier. The pinions and racks that drive the shuttle will now be exposed to view. If any teeth are broken, new parts will have to be fitted. The pinion directly beneath the shuttle carrier is secured to the carrier spindle by a small pin, which, if broken, would permit the carrier to slip out of time. In such a case, remove the carrier and pinion, and drive out the broken pieces of pin. Replace these parts, and time the shuttle carrier so that its heel (that is, the place where the loop draws off) will be level with the needle slot in the casting when it has moved round and is waiting for the loop to be cast off. Then drive a small pin through the pinion and carrier spindle to secure them. A new pinion or carrier would have to be drilled. Care should be taken not to set the shuttle carrier so as to stand over the needle slot when the loop is being formed. It should just be on one side of the slot, so as to give clearance for the loop, then, when it has moved round, there will be found just sufficient space for the release of the loop from the shuttle.

CHAPTER VI.

USEFUL ATTACHMENTS AND AUXILIARY DEVICES.

A HAND attachment that can easily be fixed to a treadle sewing machine is shown in end and side elevation by Figs. 81 and 82. The angle piece A, which is $2\frac{1}{4}$ in. wide and $2\frac{7}{8}$ in. deep, is attached to the existing framework of the machine by a stud passing through the hole (see Fig. 82). One end of the angle piece has a groove $\frac{5}{8}$ in. wide and $\frac{1}{8}$ in. deep, which engages a projection in the machine; this tongue may be a thin strip of metal screwed in position. The upper part of the angle piece has two lugs (see Fig. 82) which are secured to the gear case B by two short countersunk screws $1\frac{5}{8}$ in. apart. Fig. 83 shows a longitudinal vertical section of the angle piece, and Fig. 84 a horizontal section at x x (Fig. 82), the dimensions at this part being 1 in. by $\frac{1}{3}\frac{3}{2}$ in.

The gear case is $\frac{1}{2}$ in. thick, $4\frac{3}{8}$ in. deep, by $3\frac{1}{2}$ in. wide, the top part being $1\frac{7}{16}$ in. wide. It has a circular opening C at the back $1\frac{5}{16}$ in. in diameter, and another, D (Figs. 85 and 86) in front, $3\frac{3}{8}$ in. in diameter. Figs. 85, 86, and 87 are respectively back elevation with part removed, vertical section, and horizontal section. At the centre of the back is a projection E tapped to receive the screwed stud on which the large toothed wheel revolves. This wheel has sixty teeth and a pitch diameter of $2\frac{7}{8}$ in. It has a boss F on which the head of the stud bears.

Cast on each side of the centre are two forked projections G and G′, provided with holes $\frac{1}{8}$ in. in diameter. They are 1 in. long by $\frac{7}{16}$ in. wide, the central gap being $\frac{3}{8}$ in. in each case. In front is a smaller projection H, which receives the screwed

stud on which the smaller toothed wheel revolves. This has twenty teeth and a pitch diameter of $\frac{7}{8}$ in. Of course, the parts on which the toothed wheels revolve are not screwed. The gear case has also on the inside two projections J to which the cover (Fig. 88) is fixed. On the outside of the case is a

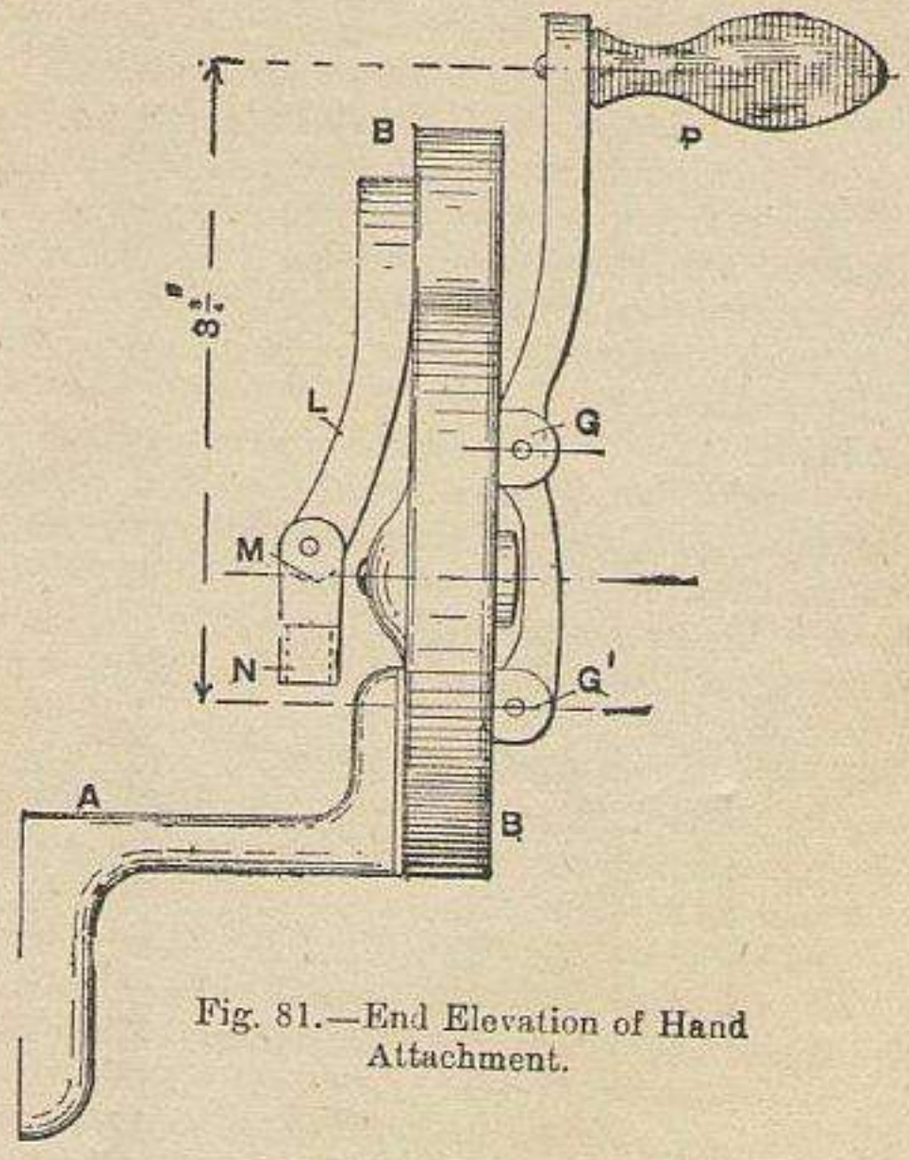


Fig. 81.—End Elevation of Hand Attachment.

raised part K of the shape shown in Fig. 89 (indicated by vertical hatched lines), the interior being of the general level of the casing. Against this projection rests the angle piece A.

The arm L runs on the stud of the smaller toothed wheel, the head of the stud being let in as shown by Fig. 86. This arm is shown separately

by Figs. 90 and 91. It is $2\frac{3}{8}$ in. long, and is circular at the top, tapering to $\frac{1}{4}$ in. at the bottom (see Fig. 91). Pivoted to its lower end is a forked piece M (Figs. 81 and 82) shown enlarged by Figs. 92 and 93. The upper part is $\frac{3}{8}$ in. thick by $\frac{9}{16}$ in. wide;

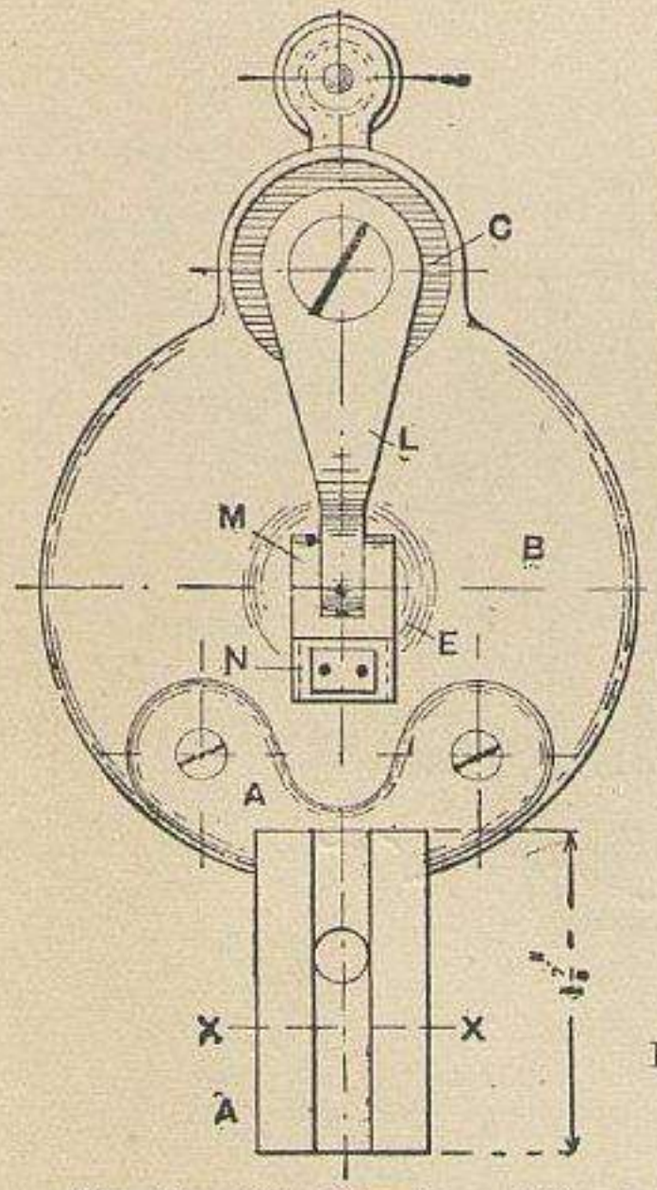


Fig. 82.—Side Elevation of Hand Attachment.

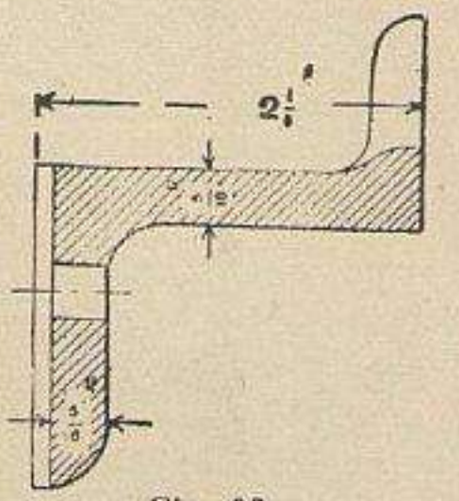


Fig. 83.

Fig. 84

Figs 83 and 84.—Sections of Angle Piece.

the lower part, $\frac{1}{2}$ in. wide by $\frac{5}{16}$ in. thick and $\frac{11}{32}$ in. long, is covered with a leather band N (Fig. 81) to come flush with the other part. This band is fixed by means of stout wire passing through and riveted to a thin plate (see Fig. 94).

The bottom of the arm (Figs. 90 and 91) has

two depressions which engage with a small projection at the bottom of the fork (see Fig. 93), the object being to allow the forked piece M to assume a position either at right angles to the arm L or as a continuation of this arm as at Fig. 81.

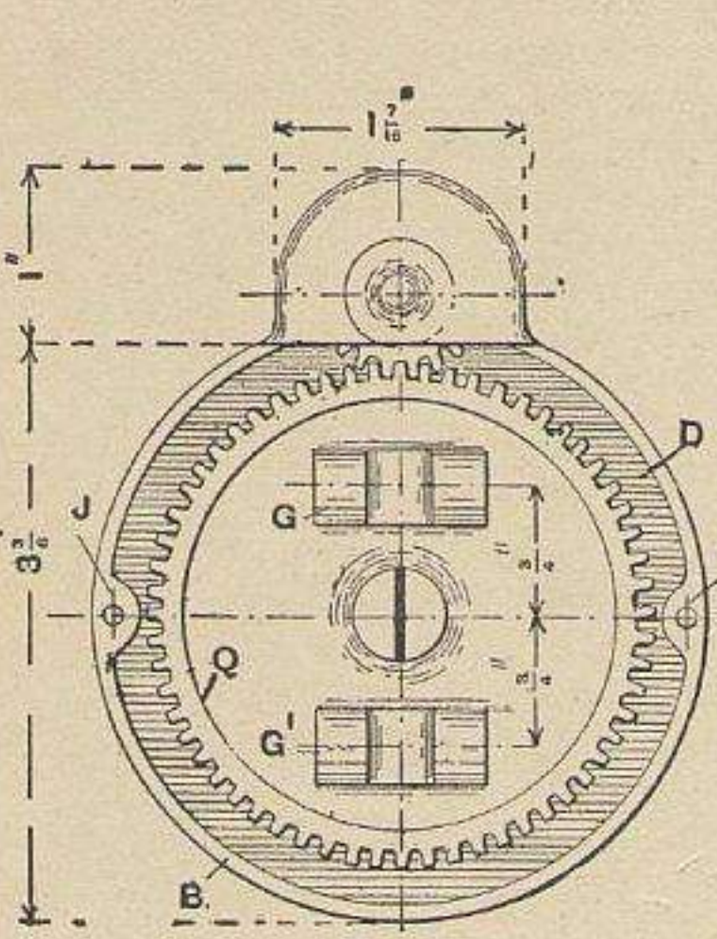


Fig. 85.

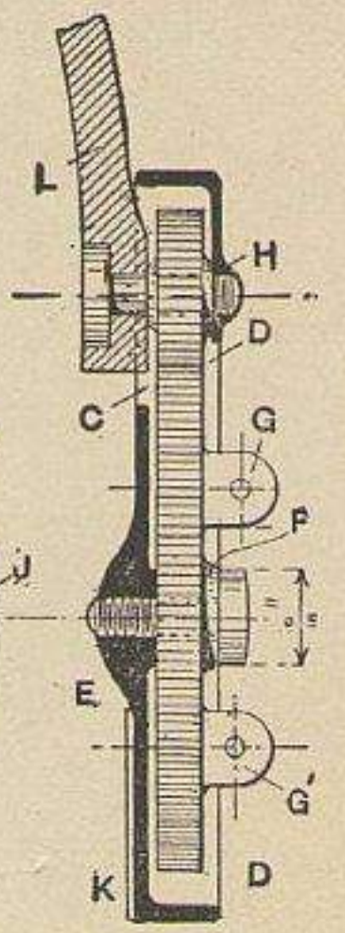


Fig. 86.

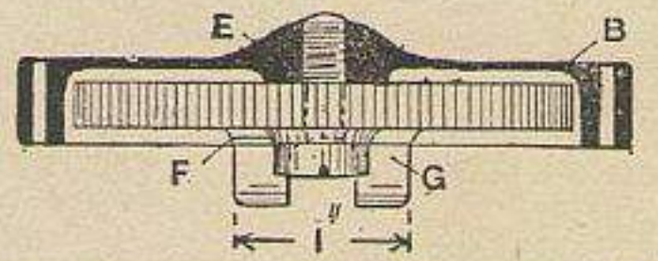


Fig. 87.

Fig. 85—Elevation of Gear Case with Cover Removed.
Figs. 86 and 87.—Sections of Gear Case.

The handle, shown separately at Figs. 95 and 96, is $4\frac{3}{16}$ in. long, $\frac{3}{8}$ in. wide, by $\frac{1}{4}$ in. thick, and is linked by means of a pin through the circular part at the bottom to the lower forked piece G′ (see Fig. 81), whilst the flattened part, $\frac{1}{4}$ in. long, rests

in the upper piece G. A pin fixed in the left-hand side of G projects slightly so as to engage with the recessed part O (Fig. 95) (see also section, Fig. 97) when pressed firmly. The part P is turned in hard

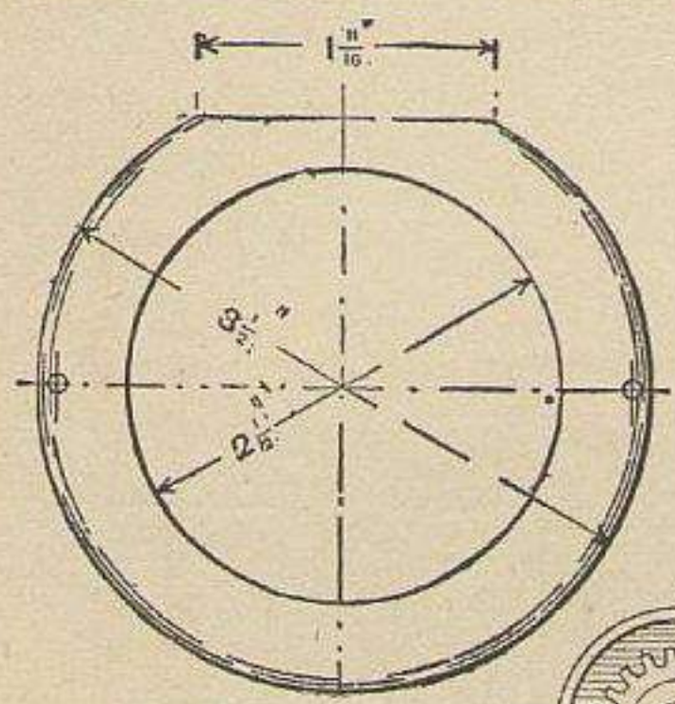


Fig. 88.—Gear-case Cover.

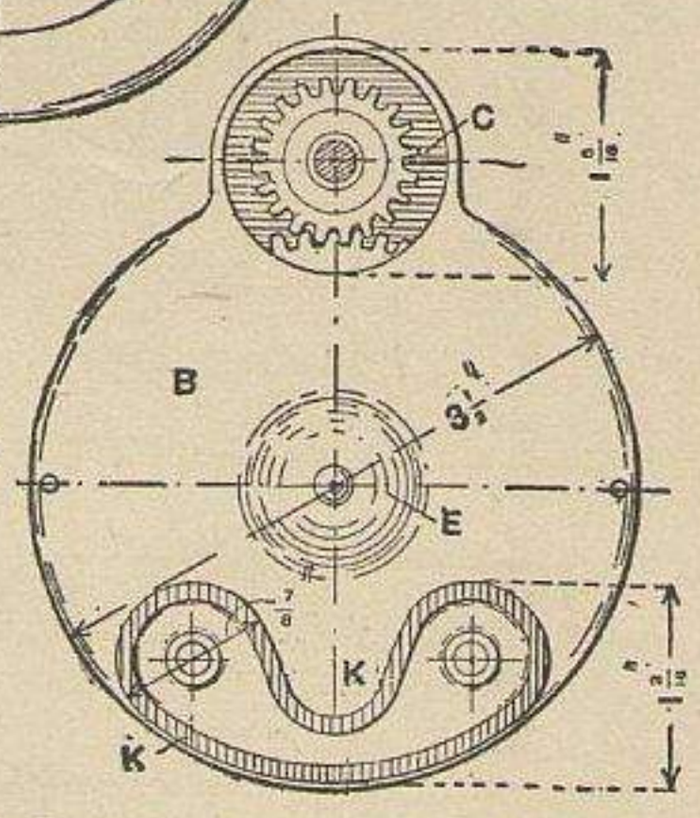


Fig. 89.—Elevation Gear Case.

wood (preferably ebony). It is $1\frac{3}{4}$ in. long by $\frac{3}{4}$ in. in diameter, and is fitted with a centre spindle. The handle is curved to clear the stud on which the large wheel revolves.

When in use the cover (Fig. 88) is screwed over the open part (Fig. 85), the inner diameter of the

cover, 2½ in. in diameter, corresponding with the recessed part Q of the wheel (see Fig. 85).

The mode of operation is as follows: The

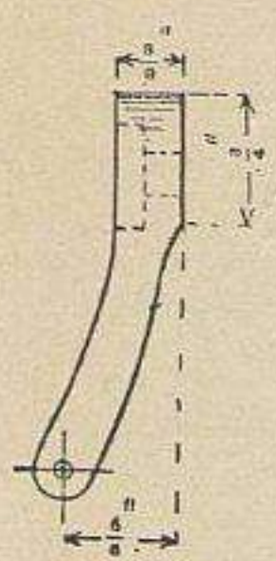


Fig. 90.

Fig. 91.

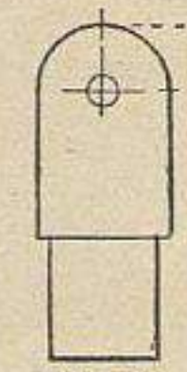


Fig. 92.

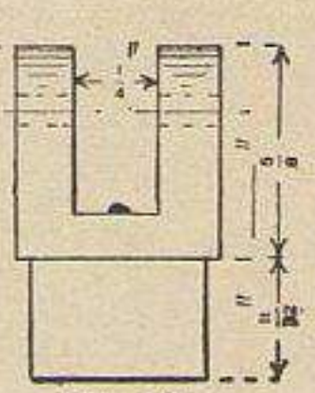


Fig. 93.

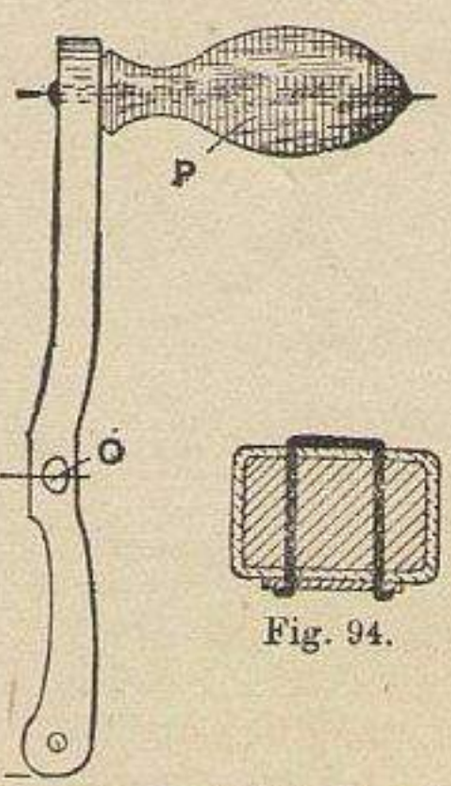


Fig. 95

Fig. 94.

Fig. 96.

Figs. 90 and 91.—Arm. Figs. 92 and 93.—Forked Piece. Fig. 94.—Section of Forked Piece. Figs. 95. and 96.—Handle.

appliance is attached to the machine so that the piece M, when at right angles to the arm L, engages the arms of the wheel next the pulley wheel.

Then by turning the handle the arm will revolve at three times the speed of the handle. When not in use the handle can be moved back right out of the way. If the wheel in the existing machine is solid, then a forked piece could be fitted so that the piece M could engage with it, or, easier still, a hole could be bored in the wheel. The above dimensions, especially the lengths of the angle piece A and the arm L, may be varied to suit individual cases. If the side of the machine is

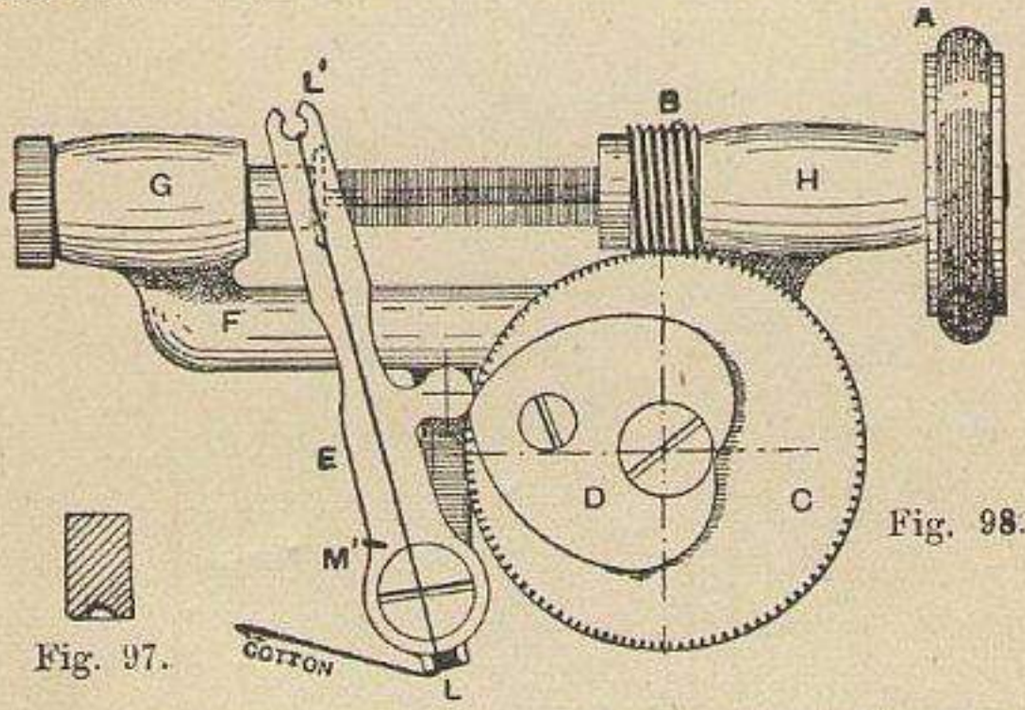


Fig. 98.

Fig. 97.

Fig. 97.—Section of Handle. Fig. 98.—Front Elevation of Bobbin Winder.

flat, there will be no need for the groove, but then two holes will be necessary, one at the top and the other at the bottom of the bracket. The pieces L and M, the handle, and the studs are made of steel, whilst the remaining parts are of cast-iron.

An ordinary bobbin winder which can be fixed to a sewing machine possessing a hand attachment is shown in front and side elevation by Figs. 98 and 99. In operation the driving wheel of the machine drives the wheel A by friction, and so causes the screw B to work the wheel C. Moving with this wheel is a heart-shaped cam D which

moves the lever E, a spring at the bottom keeping the lever always in touch with the cam. The bobbin, when in position, simply has one or two turns of cotton wound on it, and the cotton is then passed through the top of the lever, down

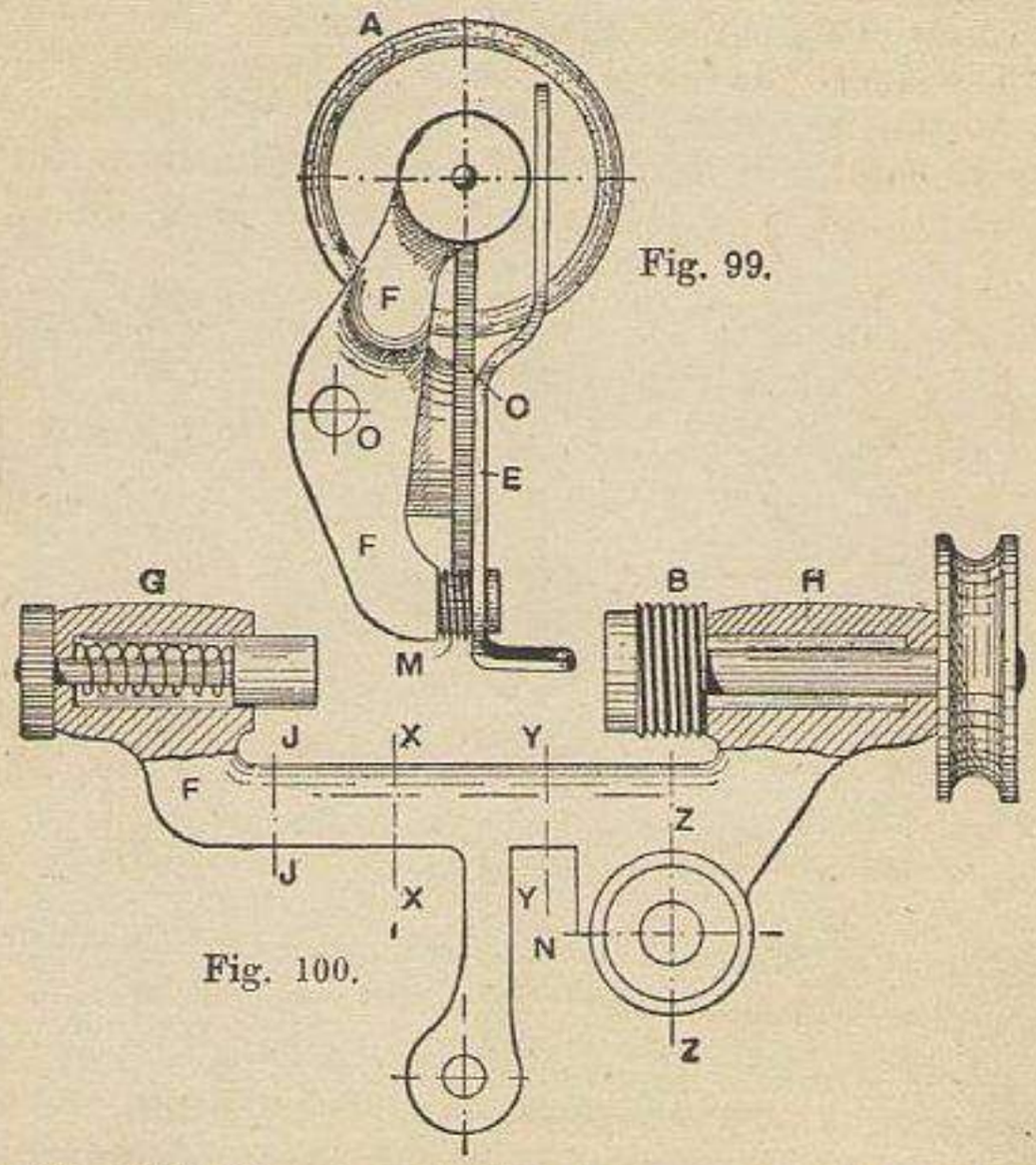


Fig. 99.

Fig. 100.

Fig. 99.—Side Elevation of Bobbin Winder. Fig. 100.—Main Casting of Bobbin Winder.

as indicated and through the loop at the head of the machine, and finally to the reel on the spindle.

The iron casting is of the shape shown in Fig. 100, and is solid. The part G is barrel-shaped, and is $\frac{3}{4}$ in. long, with an outside diameter of $1\frac{7}{8}$ in., and is bored $\frac{1}{4}$ in., except that the hole

for the spindle at the left-hand end is $\frac{1}{8}$ in. in diameter. The part H is the same diameter inside and out as G, but $\frac{7}{8}$ in. long. The lower part F varies in section, for at J J it is circular in section, and at X X it is irregular, as shown in Fig. 101. Fig. 102 is a section at Y Y, and Fig. 103 a section at Z Z (Fig. 100). In G works a steel spindle, $\frac{1}{4}$ in. in diameter, for a length of $\frac{3}{8}$ in., and $\frac{1}{8}$ in. in diameter for a length of $\frac{3}{4}$ in. The milled head is $\frac{1}{2}$ in. in

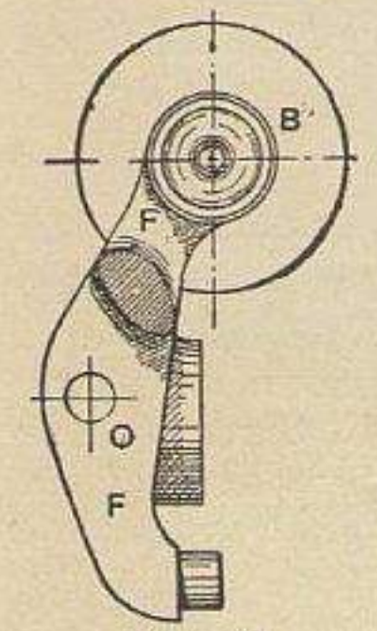


Fig. 101

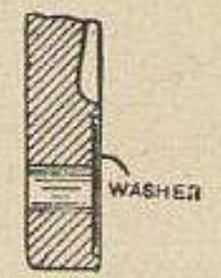


Fig. 103.

Fig. 102.

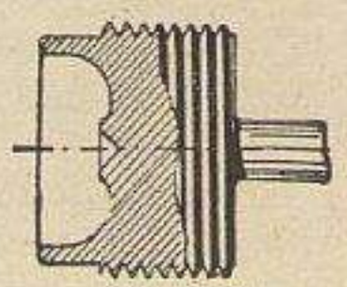


Fig. 104.

Fig. 101.—Cross Section of Casting. Figs. 102 and 103.—Other Sections of Casting. Fig. 104.—Section of Bobbin Driver.

diameter, and $\frac{1}{8}$ in. thick. In the hollow part H works a $\frac{1}{4}$-in. spindle, which has an enlargement at one end $\frac{1}{2}$ in. in diameter, on which is cut a screw thread. An enlarged section of this end is given in Fig. 104, which shows the centre that receives one end of the bobbin. The other end of the spindle is fixed to the pulley, which is 1 in. outside diameter and $\frac{5}{16}$ in. thick. The spindle could be square where it passes through the pulley.

In the groove is placed a circular indiarubber ring, as shown in Fig. 98. This ring is $\frac{1}{4}$ in.

diameter in section, and $1\frac{1}{4}$ in. outside diameter. Gearing with the screw is a wheel (Fig. 105), the edge being cut to suit the screw. It is $1\frac{9}{16}$ in. in diameter and $\frac{3}{32}$ in. thick, and has two holes,

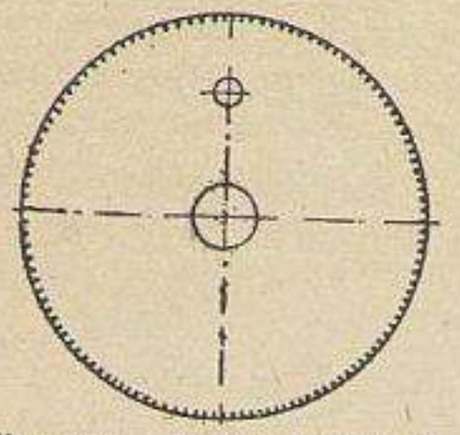
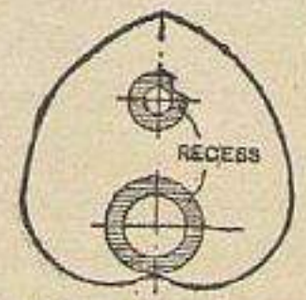


Fig. 105.—Toothed Wheel.

Fig. 106.—Stud for Wheel.

$\frac{1}{4}$ in. and $\frac{1}{8}$ in. diameter, the former being at the centre of the wheel, the centre of the other being barely $\frac{1}{2}$ in. distant. The centre pin is shown in Fig. 106. The head is $\frac{3}{8}$ in. in diameter and $\frac{1}{16}$ in. thick, the middle part is $\frac{1}{4}$ in. in diameter and $\frac{1}{3}$ in. long, whilst the lower part is about $\frac{1}{2}$ in. long and about $\frac{1}{8}$ in. in diameter. It is fixed at the back by a small nut.

Fig. 107.



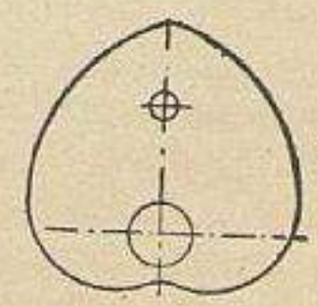


Fig. 108.

Figs. 107 and 108.—Front and Back Views of Cam.

On this wheel is fixed a heart-shaped cam (Figs. 107 and 108) 1 in. deep, 1 in. wide, and $\frac{1}{12}$ in. thick. It is also provided with two holes to agree with those in the wheel, but recessed for about $\frac{1}{64}$ in. for the head of the screw. The point of the cam reaches nearly to the outside of the wheel. The cam is fixed to the wheel by a stud (Fig. 109), the head of which is $\frac{1}{4}$ in. in diameter

and $\frac{1}{32}$ in. thick, and the shank $\frac{1}{8}$ in. in diameter and $\frac{1}{8}$ in. long. As this cam revolves it moves from right to left a projection on the lever (Fig. 110). This is $2\frac{1}{4}$ in. long, as measured on the centre line, and $\frac{1}{16}$ in. thick.

There are two projections, one K being more or less egg-shaped, the centre of the circle being $1\frac{1}{4}$ in. from the top of the lever, measuring parallel to the centre line, and about $\frac{5}{16}$ in. from it. The second projection L is $\frac{3}{8}$ in. long, and bent up at right angles and cut similar to the top L^1. The

Fig. 109.—Stud for Cam.

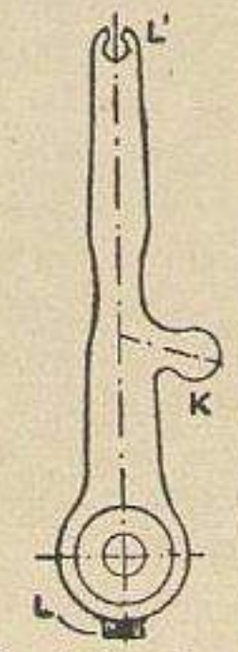


Fig. 110.—Lever.

Fig. 111.—Stud for Lever.

bottom of the lever is circular with a diameter of $\frac{1}{2}$ in., then rounding to a width of $\frac{5}{16}$ in., and finally tapering to a width of $\frac{3}{16}$ in. at the top. At $\frac{3}{4}$ in. from the top the lever is curved concave fashion for a distance of $\frac{5}{16}$ in., and also bent as shown in Fig. 99. As the cotton passes through the loops at the top and bottom of the lever E the edges should be rounded so as not to cut the cotton. A $\frac{3}{8}$-in. hole is bored at the bottom for about $\frac{1}{64}$ in., and finally reduced to $\frac{3}{16}$ in. diameter. This lever is pivoted to the framework by means of the screw (Fig. 111), its head being $\frac{3}{8}$ in. in diameter and $\frac{1}{16}$ in. deep, and

the screwed part being $\frac{3}{16}$ in. in diameter and $\frac{1}{4}$ in. long. The lever is pressed against the cam by means of a spiral spring M round the projection on the framing (see Fig. 99), the end of the spring being hooked over the lever as at M^1 (Fig. 98).

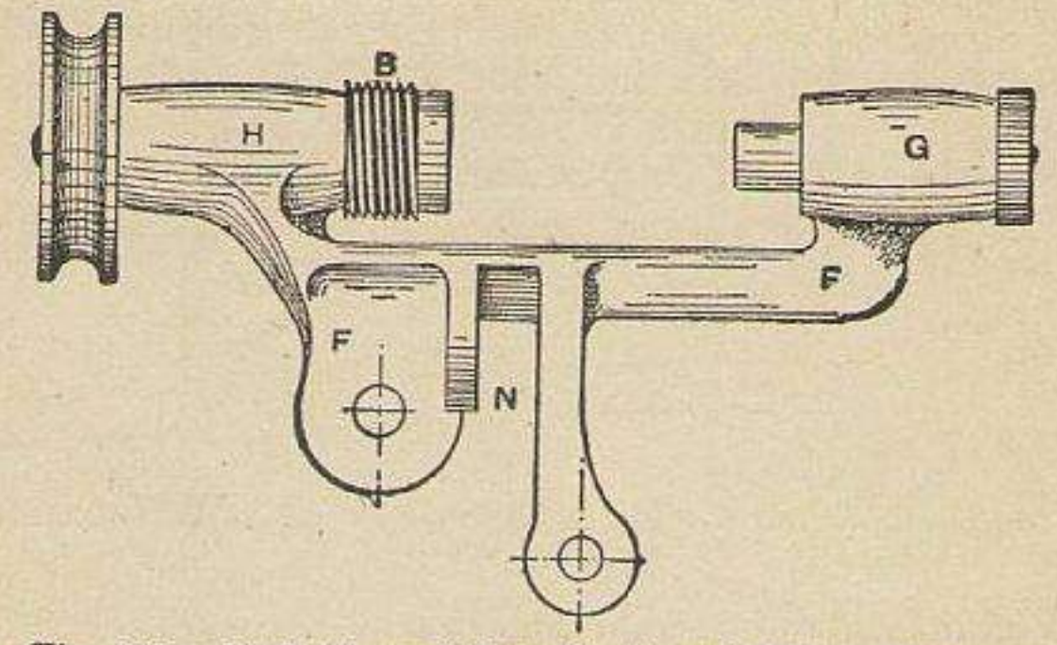


Fig. 112.—Back View of Main Casting of Bobbin Winder.

The appliance is adjusted to the existing framework of the machine by fitting the forked part N (Figs. 100 and 112) to a piece (Figs. 113

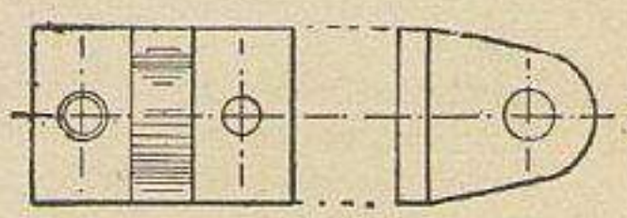


Fig. 113. Fig. 114.

Figs. 113 and 114.—Bracket Piece.

and 114), which is screwed in place. This must be fixed on the machine, so that, by tilting the appliance slightly, the rubbered wheel presses against the hand wheel. The projection, as shown in Figs. 113 and 114, is $\frac{1}{8}$ in. thick, 1 in. long, and $\frac{5}{8}$ in. wide, with a middle piece projecting $\frac{5}{8}$ in., as shown by the side view. Two holes are drilled so that the piece can be screwed

in position, and a hole $\frac{3}{16}$ in. in diameter takes the fixing screw (Fig. 115). This screw has the head $\frac{1}{4}$ in. in diameter and $\frac{1}{8}$ in. long, and the

Fig. 115.

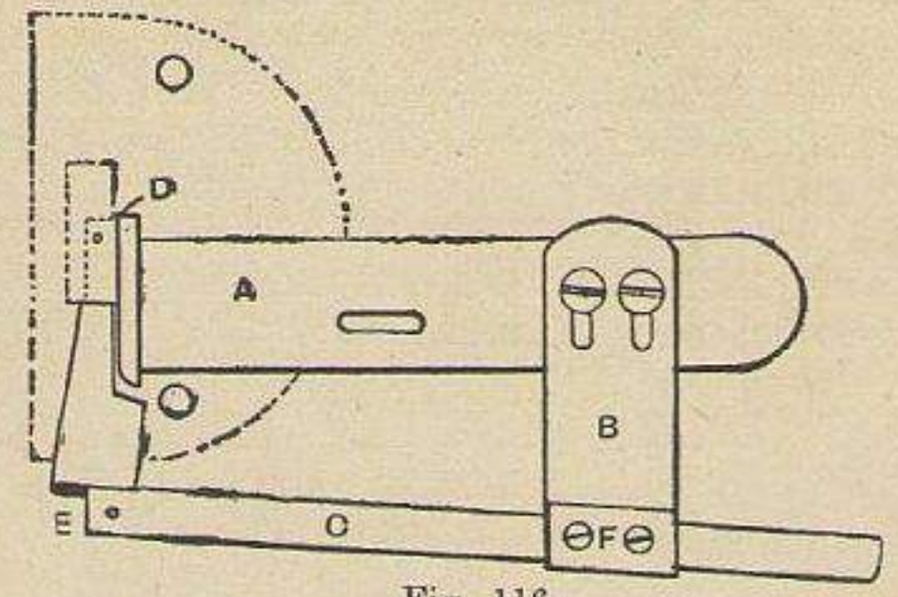


Fig. 116.

Fig. 115.—Stud for Fixing Appliance. Fig. 116.—Plan of Welting Device.

shank, about $\frac{3}{4}$ in. long, passes through the hole o (Figs. 99 and 101). Obviously the dimensions of this piece vary according to the framework to

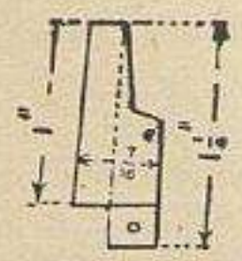


Fig. 117.—Tube Guide.

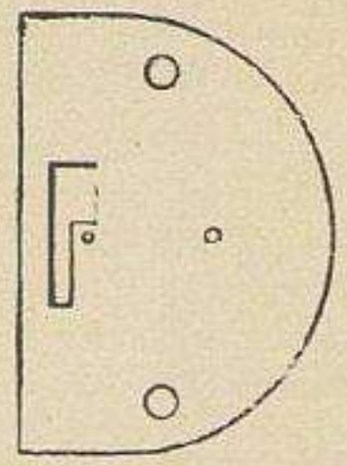


Fig. 118.—Needle-plate.

which it may be fixed. In some cases this piece cannot be used at all, but, instead, a standard should be screwed to the base of the machine. All working parts are of polished steel. In working, the bobbin is placed as in Fig. 98, its ends resting in recesses in the pins.

A welting device for a sewing machine will now be described. Fig. 116 is a plan of a sewing machine attachment for inserting a welt between two pieces of material, as required in the making of men's and ladies' boots, leggings, etc. The welting can be purchased on reels holding from 250 yd., and may be had in various shades and sizes, according to requirements. It is essential that a good quality welting be used, and that its size (that is, width and substance combined) is regular and reliable, otherwise perfect work is impossible.

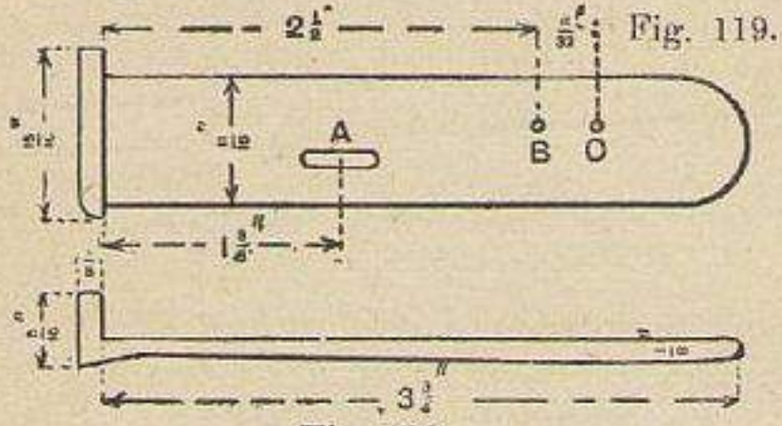


Fig. 120.

Figs. 119 and 120.—Plan and Elevation of Solid Guide.

Fig. 121.—Extension Arm.

When making this attachment, first determine the size of the welting to be used, and make the tube (Fig. 117) so that the welting will pass through very freely, and yet fit perfectly. The attachment may be fitted to either a drop-feed or a wheel-feed sewing machine, but works better on drop-feed machines. When possible, they should be fitted with a needle-plate, having a feed of the pattern shown in Fig. 118. The feed in the machine must correspond with the needle-plate. The attachment consists chiefly of a solid guide A (Fig. 116), shown separately by Figs. 119 and 120, and an adjustable extension arm B, $\frac{1}{8}$ in. thick, shown separately by Fig. 121, to which is secured a spring guide C. The guide A is fastened

with a thumbscrew to the bed of the machine; usually bed-plates of sewing machines are drilled and tapped to the right of the needle for the reception of guides and other appliances. When this is so, the guide A should be drilled so as to utilise the tapped holes in the bed-plate; otherwise drill according to the measurements given in the illustrations. This guide must be fixed to the machine bed-plate in such a position that the rear portion D (Fig. 116) will stand behind the needle about $\frac{1}{16}$ in.

To make the attachment, proceed as follows: Select a piece of mild steel, $\frac{3}{4}$ in. by $\frac{1}{8}$ in., and cut off about 1 ft., so that it can be handled easily. Heat one end to a bright red; then hold it in a vice, and bend it to a right angle, as

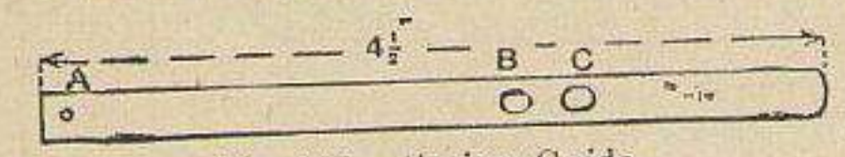


Fig. 122.—Spring Guide.

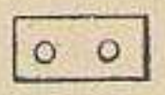


Fig. 123.—Washer.

shown in Fig. 120; then cut to about 4 in. long. The angle-piece may be dovetailed and brazed to the flat piece if preferred, and left wider, as shown in Fig. 116; or, if the material to be welted has sharp curves, the end may be gradually rounded from the front edge up to the needle. Next true the bottom of the guide to a surface plate, if one is available; if not, it must be filed and fitted so as to set level on the bed-plate of the sewing machine. Then true the angle-piece by using a set-square, and afterwards finish to shape. Fig. 120 shows the guide slightly hollowed at one end—which would be necessary if the needle-plate projected above the bed-plate. Any irregularity or unevenness on the bed-plate must be dealt with afterwards. Finish it to the shape and size indicated in Figs. 119 and 120. To mark hole A, set it out $1\frac{3}{8}$ in. from the inside of the angle and $\frac{1}{4}$ in. from the front edge of the guide

(as shown), unless it is intended to use any hole already drilled in the bed-plate. Mark out holes B and C by measuring $2\frac{1}{2}$ in. from the inside of the angle and about $\frac{1}{4}$ in. from the rear edge of the guide; this gives the position of the hole B. Set out hole C $\frac{11}{32}$ in. to the right of B. These holes should be tapped $\frac{1}{8}$ in., and about 40 pitch of thread. Hole A should be drilled $\frac{1}{8}$-in. clearance, and then slotted to allow for the adjustment of the guide.

The extension arm (Fig. 121) should be made of the same material as the guide, and when finished should be 2 in. long by $\frac{11}{16}$ in. wide by $\frac{1}{8}$ in. thick, rounded at the upper end and left square at the bottom. The holes A and B should

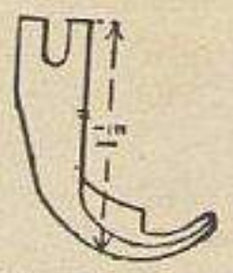


Fig. 124.—Presser Foot.

be marked out $\frac{3}{16}$ in. from the square end, and $\frac{11}{32}$ in. apart. Drill and tap for $\frac{1}{8}$-in. screws, 40 pitch. Mark holes C and D $1\frac{1}{2}$ in. from A and B, also $\frac{11}{32}$ in. apart; then slot them downwards, making them $\frac{3}{8}$ in. long.

The tube guide (Fig. 117), through which the welting passes to the needle, is made from a block $1\frac{1}{4}$ in. long by $\frac{1}{4}$ in. wide, as indicated by the dotted lines, the thickness being determined by the substance of the welting to be used. A piece of very thin sheet steel or brass is folded over this block, and soldered to it, forming a tube on the left side. The length of the tube is 1 in., and the width according to the welting used. The block is cut away at the right-hand side, as shown in Fig. 117, to allow the welting to press against, and to be supported by, the main guide A (Fig.

116). The entrance to the tube may be slightly enlarged to admit the welting easily (see E, Fig. 116). A $\frac{1}{16}$-in. hole should be drilled in the tube block, as shown in Fig. 117. The greatest width, it will be seen, is $\frac{7}{16}$ in., the block being $\frac{1}{4}$ in. The tube is for $\frac{3}{16}$-in. welting; for wider welting, use the same size block, but extend the tube more to the left.

The spring guide (Fig. 122), to which the tube is attached by means of a rivet, is made of spring steel $\frac{1}{32}$ in. by $\frac{1}{4}$ in., and is $4\frac{1}{2}$ in. in length. Mark out hole A $\frac{1}{8}$ in. from the end, and drill it to correspond with the hole in the tube. Hole B is $2\frac{5}{8}$ in. from A, and is drilled $\frac{1}{8}$-in. clearance. Mark C $\frac{11}{32}$ in. to the right. These two holes should be slotted, to allow for adjusting the tube independently of the guide A (Fig. 116). Fig. 123 shows a washer, $\frac{11}{16}$ in. by $\frac{3}{8}$ in. by $\frac{1}{16}$ in., having two $\frac{1}{8}$-in. holes drilled $\frac{11}{32}$ in. apart; this acts as a clamp to secure the spring guide to the adjustable arm (see F, Fig. 116).

Fasten the parts of the attachment together, as shown in Fig. 116, and attach it firmly by means of a thumbscrew to the bed-plate of the machine. Adjust it so that the needle will penetrate the welting fully $\frac{1}{32}$ in. from its left edge. To operate it, thread the welting through the tube, place one piece of material under the tube (the spring guide allowing for varying substances), another piece over the tube, and bring down the presser foot. Hold the material firmly against the guide A (Fig. 116), and proceed to sew in the usual way. The seam will be closed and a welt inserted, giving the work a nice finished appearance, as well as making the locking of the stitches imperceptible. Fig. 124 shows how the presser foot should be cut away to allow the tube to be adjusted near to the needle if necessary. The prong or toe of the foot must be well rounded, or turned up, so as not to pucker the material.

This device does not prevent the machine from being used for ordinary stitching. By taking out the large thumbscrew from the hole in the guide A (Fig. 116), the attachment can be removed, and the machine worked as usual.

A ruffler or gatherer may easily be attached to any modern sewing machine. In Fig. 125, the presser foot and ruffler are shown all in one, but it would be quite a simple matter to make this attachment so as to fix on the presser foot by means of two screws. Forms of presser feet vary according to the shape of the presser bar to

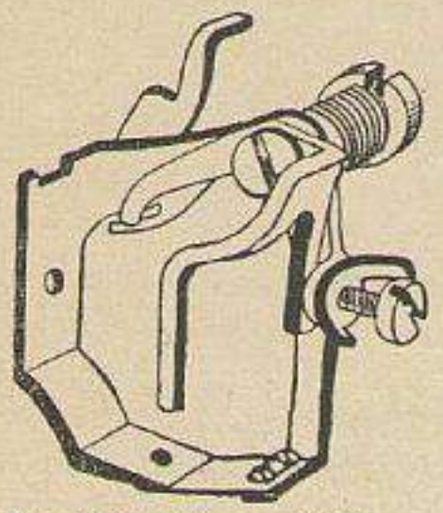


Fig. 125.—General View of Ruffler.

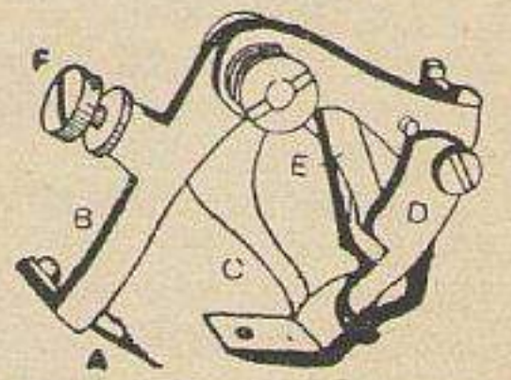


Fig. 126.—Ruffler with Crimping Blade Out of Action.

which they are attached. One kind of foot in use is a blank foot having a small hole drilled in it, through which the needle passes, and it is well bevelled from the front edge to the rear of the needle hole to admit the material as it is gathered (see Fig. 125).

The crimping blade A (Fig. 126) is attached to the lever B by means of two screws. It consists of a piece of very thin steel having at the end teeth like a saw, and with a long slot to prevent it striking the needle in its forward movement. It is shown separately by Fig. 127.

The ruffler gains its action from the needle-bar. A special needle clamp (Fig. 128), having a boss,

is placed on the needle-bar, which, as it descends, comes in contact with the ruffler lever C (Fig. 126); thus it gives motion to lever B, which holds the crimping blade A. The return action is caused by a coiled spring, which can be seen better in Fig. 125. The stop lever D (Fig. 126), if brought against the lever E, forces the crimping blade out of action, so that an operator could begin by doing a little plain stitching, then a piece of ruffling, and finish off with plain stitching. It is a simple device, but exceedingly handy.

Fig. 129 shows a special needle-plate; this,

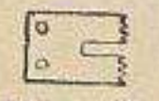


Fig. 127.

Fig. 128.

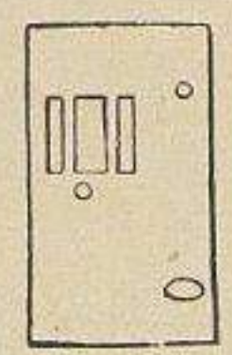


Fig. 129.

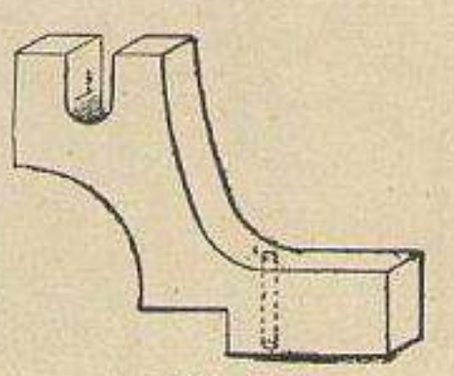


Fig. 130.

Fig. 127.—Crimping Blade. Fig. 128.—Needle Clamp. Fig. 129.—Needle Plate. Fig. 130.—Appliance for Smocking.

with a feeder to correspond, is necessary. It will be noticed that the feeder slots are behind the needle hole only. The feeder must not be in front of the needle, or the crimping blade will strike it and do damage; besides, its action would probably be impeded. Finally, F (Fig. 126) is an adjusting screw, with lock nut, by means of which the gathers may be made close or scant, as required.

The making of a ruffler or gatherer may be too difficult a job for some readers, in which case they will find that thin material can be gathered on an ordinary sewing machine by the use of a special smocking foot shaped as in Fig. 130.

A device that may be used for pleating in

accordion style, or for folding the material in the process of smocking or honeycombing, is illustrated by Fig. 131. It may be made to any desired size, according to the width of the material to be pleated, but a wooden frame, 16 in. square, would be suitable for ordinary purposes. It holds a number of thin spring steel slats, stationary and movable alternately, each having at the upper end metal washers about $\frac{1}{32}$ in. thick,

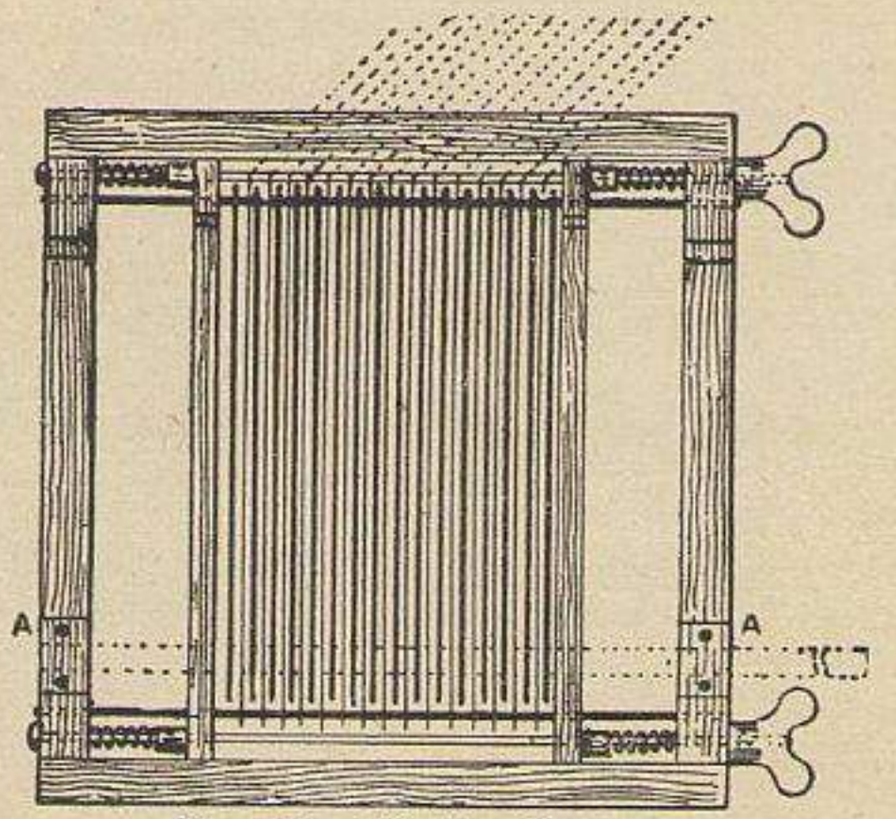


Fig. 131.—Pleating Device.

and at the lower end washers about $\frac{3}{32}$ in. thick. The whole is kept rigid by two long bolts, which are drawn tight by a pair of wing-nuts. The material is placed over the stationary steel slats, and by bringing down the movable slats the material is forced between the long slats and formed into pleats.

The top (Fig. 132) and the bottom (Fig. 133) of the wood frame are both $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by 16 in., and cut out at A and B. The two sides (Fig. 134) also are $1\frac{1}{2}$ in. by $1\frac{1}{2}$ in. by 16 in. One side is a

fixture, and the other is a tight yet movable fit in B (Figs. 132 and 133), in case of adjustment by the screw. Two movable wooden slides (Fig. 135) admit through the outer holes the two $\frac{5}{16}$-in. bolts, 18 in. long, and through holes C and D wire rods. The wood slides, actuated by two springs and sleeve collars or bushes, help to keep the steel slats rigid. The slides should be about 13 in. long, and at the end $1\frac{1}{2}$ in. by $\frac{3}{4}$ in., hollowed out and fitted so as to slide easily though firmly in the frame between the top and bottom. A plain wooden bar, $\frac{1}{2}$ in. by $\frac{3}{4}$ in. by 16 in., acts as a

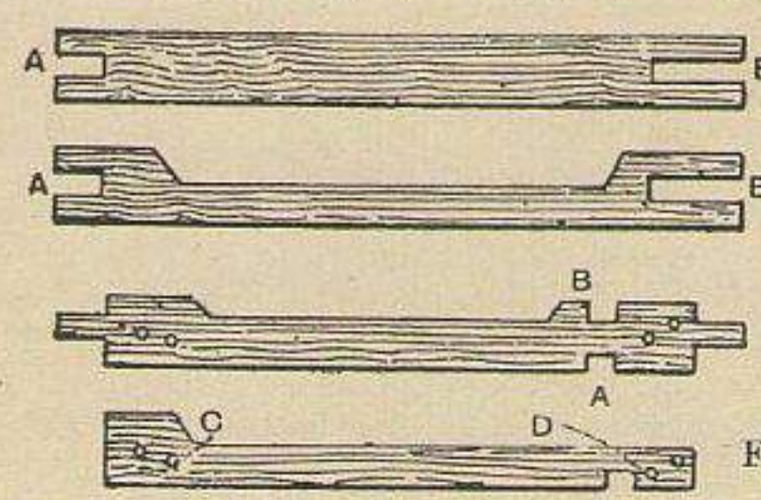


Fig. 132.

Fig. 133.

Fig. 134.

Fig. 135.

Fig. 132.—Top of Frame. Fig. 133.—Bottom of Frame. Fig. 134.—Side Piece. Fig. 135.—Slide.

support to the frame, and is fixed at the rear side in the recess A (Fig. 134). A wooden slide, $\frac{3}{4}$ in. by $9\frac{1}{2}$ in. by 18 in., if placed in the recess B, keeps the movable steel slats in position during the process of ironing. The long stationary steel slat is about $\frac{1}{16}$ in. by $\frac{1}{4}$ in. in section, and reaches to the long bolts. Also about twenty-five short movable slats, say $\frac{1}{32}$ in. by $\frac{1}{4}$ in., and terminating as shown in Fig. 131, will be required. A wooden bar, $\frac{1}{2}$ in. by $\frac{3}{4}$ in. by 16 in., acts as a support.

In constructing the pleating device, fit the ends of the sides into the slots in the top and bottom. Then add the movable sides, holding them in position at each end by the two long bolts. Pass

each bolt through the hole in one side piece; then thread on a spiral spring and bush, pass the bolt through the slides (Fig. 135), thread on another bush and spring, pass the bolt through a side, and attach a wing-nut. The springs are of No. 11 s.w.g. steel, 2 in. long by $\frac{3}{8}$ in. in diameter, and the bushes are $\frac{3}{4}$ in. long by $\frac{1}{2}$ in. in diameter.

Now add the plain wooden bar, securing the left end. The stationary slats rest on this bar, and if desired another similar stay may be placed towards the upper end of the frame; this would prevent the slats bending during the ironing pro-

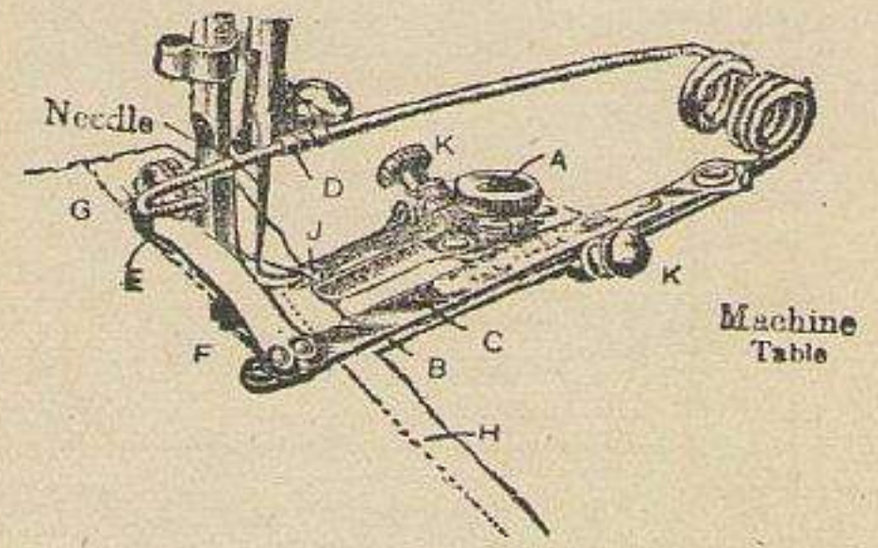


Fig. 136.—View of Tuck Marker.

cess. Screw the brass plates A (Fig. 131) over the recesses B (Fig. 134), and fit freely the wood slide, afterwards withdrawing it.

Now proceed to thread the slats on the two wire rods. These are of No. 16 s.w.g. steel, and are long enough to go through both sides of the frame. The long slats are threaded on both wires, which hold them stationary, whilst the short slats are threaded on the top wire only, so that they may be raised to admit the material as shown dotted in Fig. 131. Of course, the metal washers must be placed alternately with the steel slats at their ends.

To use the pleating device, raise the short

slats, put the material over the long slats, bring down short slats to equal the number of folds or pleats required, press them firmly between the long slats, and insert the wood slide in its recess to hold the material. Now spread a wet cloth over the material and iron with a hot iron. Leave the goods in the frame to dry well. In this way the material will be pleated into folds which will retain their position and shape though handled. For smocking, these pleats should have a running stitch through them, and should then be finished by hand in the usual way to form the honeycomb appearance.

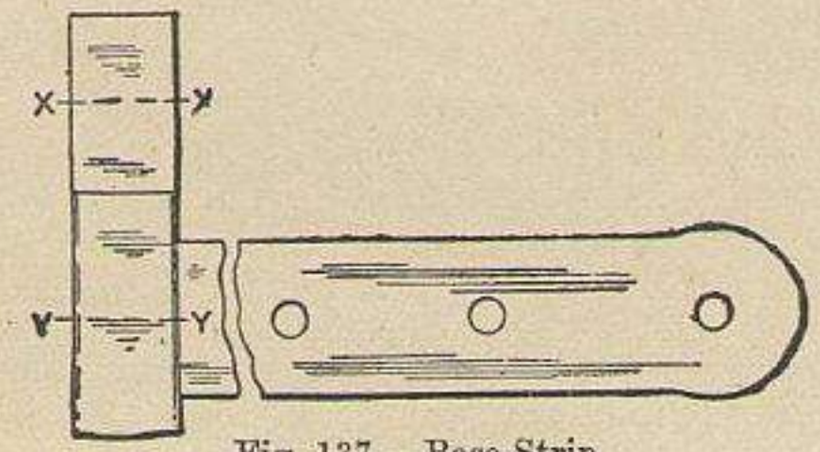


Fig. 137.—Base Strip.

A tuck marker is almost a necessity on account of the neatness it imparts to the finished work and the saving of labour effected. Fig. 136 shows a general view of one style of this attachment. The distance between the tucks and the depth of the tuck are made a constant quantity, thus assuring perfect evenness. In operation, the device is fixed to the machine table by a screw A, and the material to be worked placed between a base strip B and a spring strip C. The spring arm is then caused to move up and down by means of a hooked runner D, which engages with the needle-holder on the machine, so that the spring arm at E depresses at short intervals a curved arm and its attendant V-shaped wheel F, the

material between it and a small projecting piece thus receiving regular markings. At the same time, the needle is stitching a tuck already marked. The dotted line G represents the marking on the

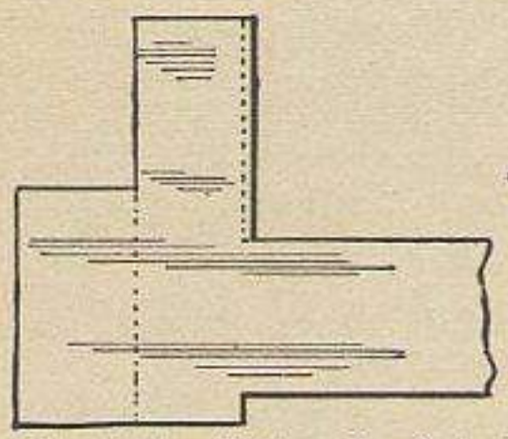


Fig. 138.—Pattern for Cutting Base Strip.

Fig. 139.—Sections of Base Strip.

next tuck, while H is the tuck being stitched, the edge of the tuck bearing against the projection J.

The tuck marker is made up of several pieces, all kept together by binding screws K, and is fairly simple as well as ingenious. It consists of a base strip (Fig. 137), formed of thin metal about $4\frac{3}{4}$ in. long, cut out as shown in Fig. 138, and so bent over on the dotted lines that sections on X X and Y Y (Fig. 137) appear as A B (Fig. 139). Fixed to the base-plate by suitable rivets is another thin strip (Fig. 140) about 4 in. long and a trifle narrower than the base-plate, and to this is fixed the curved piece shown by Figs. 141 and 142. This is the

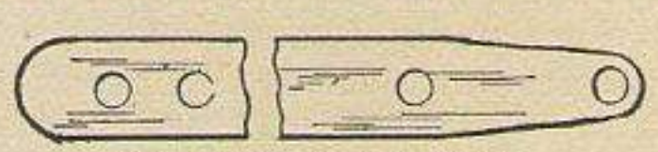


Fig. 140.—Spring Strip.

piece which is depressed by the spring arm (see Fig. 136), and so causes the wheel to mark. Fig. 142 shows the position of this wheel, while Figs. 143 and 144 illustrate the method of fixing.

The arm itself is $\frac{1}{2}$ in. in its widest and $\frac{5}{16}$ in

in its narrowest part, and is fixed to the strip (Fig. 140) by rivets as shown.

The V pulley is supported by a bent strip

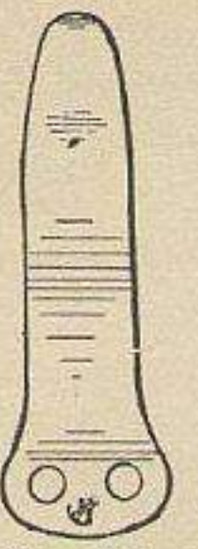


Fig. 141.

Fig. 142.

Figs. 141 and 142.—Roller Arm.

shown in side elevation in Fig. 144, and enlarged in thickness in Fig. 143. The length of the pulley and pivot is about $\frac{3}{8}$ in., the diameter of the pulley being about $\frac{1}{4}$ in. The necessity for a pulley

Fig. 144.

Fig. 143.

Figs. 143 and 144.—Details of Roller.

instead of a projecting strip is on account of the material that is being pressed moving while the marking is going on.

At the other end of the device, fixed between the base strip (Fig. 137) and the spring strip (Fig. 140), is a piece (Fig. 145) which acts as a cover to the end of the spring. This may be dis-

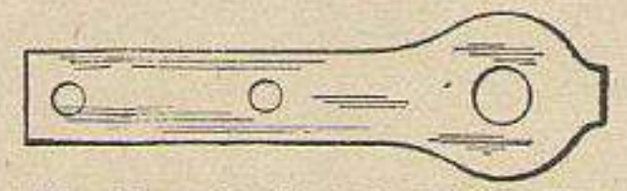


Fig. 145.—Covering Strip for End of Spring.

pensed with, however, without detriment to the working of the appliance. The spring is shown separately in Fig. 146, the end being bent over at a suitable angle to press the curved piece (Figs. 141 and 142). Figs. 147 and 148 are riveted to-

Fig. 146.—Spring.

gether through the holes shown so as to form grooves in which run the base-plate and another slide; the elongated slot takes the screw which fastens it to the machine table. The part marked M (Fig. 147) is raised slightly, to allow the

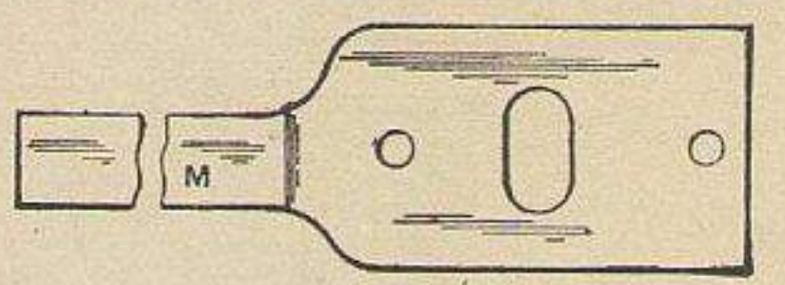


Fig. 147.—Fixing Plate.

material to pass beneath. The total length of this piece is about $2\frac{1}{4}$ in., the narrow portion being 1 in. long. Fig. 149 is a section of the plates.

When using the tuck marker the material is

passed between the base and the part N (Fig. 152, p. 134), then beneath the raised part M, and is stopped by the bent-up piece Q (Fig. 150). To form

Fig. 148.

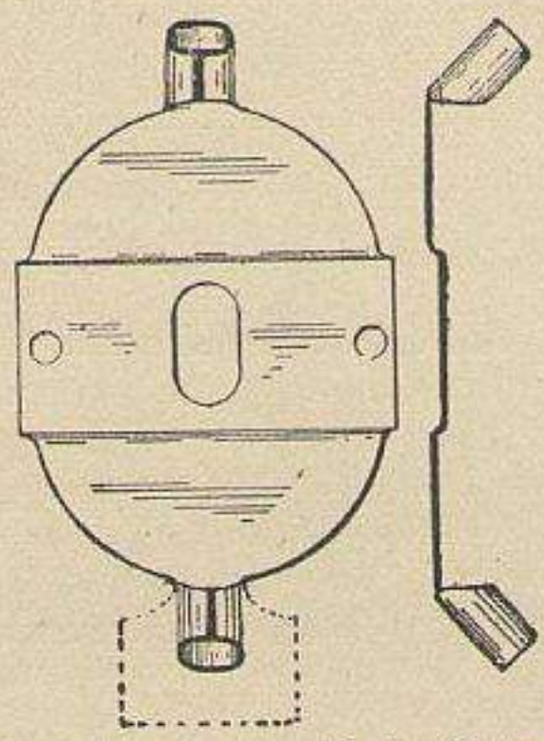


Fig. 149.

Figs. 148 and 149.—Fixing Plates.

the grooves, the centre part of Fig. 148 is also raised, as indicated in Figs. 148 and 149. At the top and bottom are two short cylindrical parts, formed by first cutting out to the dotted lines

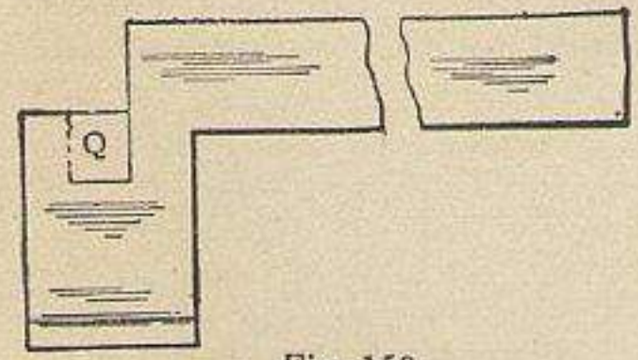


Fig. 150.

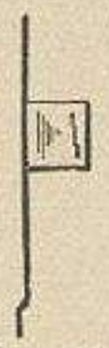


Fig. 151.

Figs. 150 and 151.—Sliding Gauge.

(Fig. 148) and bending over at an agle of 45°. This is tapped to take small screws.

The top slide is shown in detail at Figs. 150

and 151, and in position at P in Figs. 152 and 153. It is about $2\frac{3}{8}$ in. long, and is cut out of a stamping 1 in. wide to the shape of the outer full lines, then cut along the two inner full lines and bent to

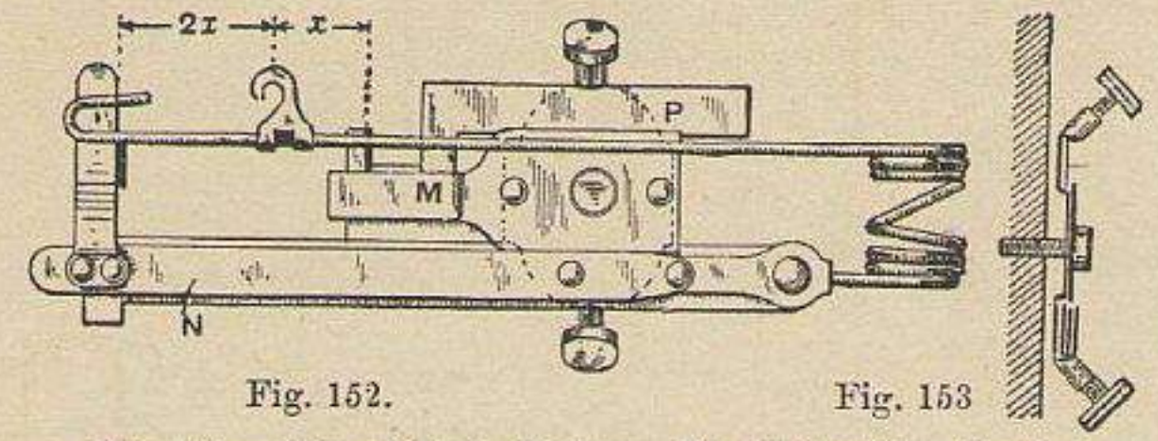


Fig. 152. Fig. 153

Fig. 152.—Plan of Tuck Marker. Fig. 153.—Cross Section of Tuck Marker.

a right angle, as indicated in Fig. 151. The bottom part is bent down (see Fig. 151) to enable the base-plate to slide easily.

All the parts are kept together by the screws (Fig. 154) passing through the cylindrical lugs (see Fig. 153).

A small runner (Fig. 155) slides along the spring arm to engage with the needle-bar and move the arm up and down. As a general rule, the distance of the needle from the projection Q (Fig. 150) is about half the distance to the grooved pulley, these distances being marked x and $2x$ (Fig. 152).

Fig. 154.—Binding Screw.

Fig. 155.—Hooked Runner.

Fig. 156 shows a piece of material with the tuck already stitched (represented by dotted lines) and another marked for use. Fig. 157 shows the tucks as finished if $2x$ is slightly decreased, the bottom

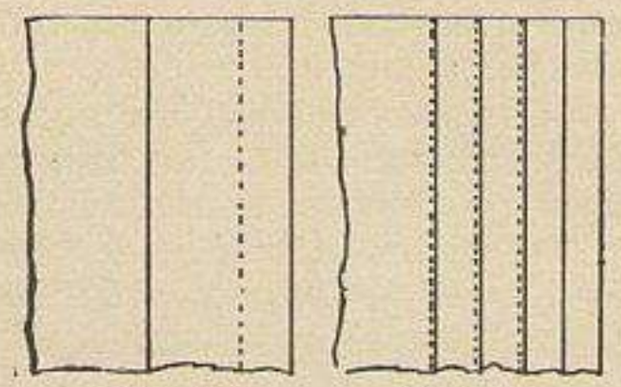


Fig. 156. Fig. 157.

Figs. 156 and 157.—Marked and Finished Work.

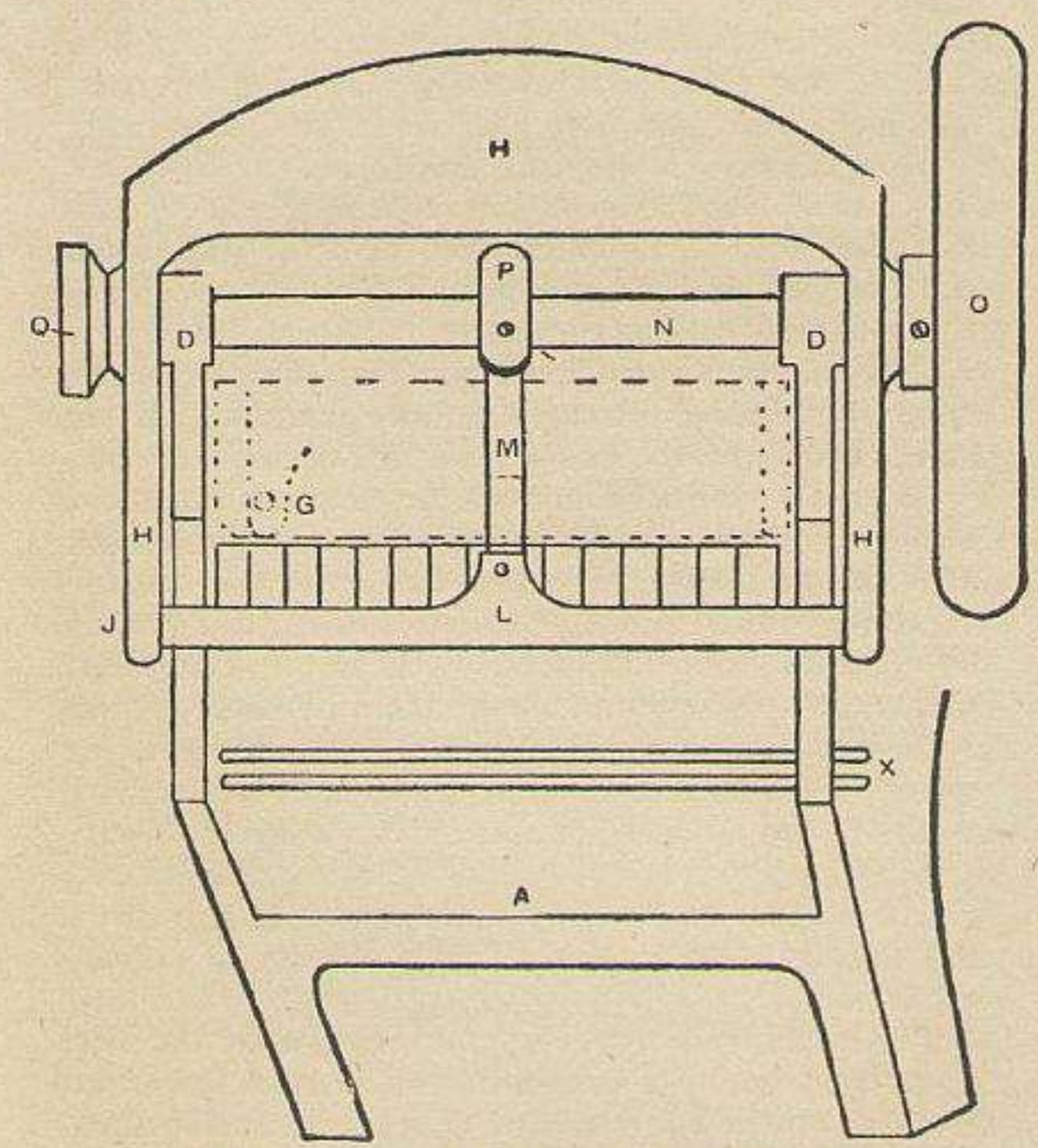


Fig. 158.—Front View of Kilting Machine.

of the tucks just overlapping the machine stitching.

Of use to sewing-machine users is a kilting machine (Figs. 158 and 159). Its bed is a casting about 10 in. long by 8 in. wide and 8 in. high. The hollow base terminates in four legs or pedestals A, and drilled at B (Fig. 159) to receive a $\frac{3}{8}$-in. stud or spindle. The hole should be marked out $3\frac{3}{8}$ in. to the rear of C and $4\frac{3}{8}$ in. below it. The two arms or supports D are fastened in a recessed part of the base by two small screws E (Fig. 159). A $\frac{1}{2}$-in. hole is drilled in each arm C to admit a shaft, and a $\frac{5}{16}$-in. hole at G to receive a heating-box stud. The rocking frame H (Fig. 158) is 1 ft. across its widest part and 5 in. high. It is drilled near the top to admit a $\frac{1}{2}$-in. shaft, and at J (Figs. 158 and 159) to receive blade rod screws, while at K (Fig. 159) it is drilled and tapped $\frac{5}{16}$ in. for a link stud screw.

The blade rod L (Fig. 158) is $10\frac{1}{2}$ in. long, and is also of cast-iron, having a projection in the centre to which is screwed a flat spring M. About fifteen thin steel blades, $\frac{1}{32}$ in. thick, are fastened to the under side by screws or rivets, and these blades are kept rigid by a bar of steel, about $\frac{1}{4}$ in. by $\frac{1}{8}$ in., placed over them and screwed to the blade rod. Screw the blade rod firmly between the rocking frame H through holes J. The shaft N is 1 ft. 1 in. long, and has a hand-wheel O, 6 in. in diameter, attached to the right-hand end, an eccentric cam P, having a $\frac{1}{4}$-in. throw, being fixed at about the middle, and a driving disc Q, $1\frac{3}{4}$ in. by $\frac{3}{8}$ in., on the left end. This disc is drilled about $\frac{3}{8}$ in. from the outer edge and tapped to receive a stud screw. Fasten the disc with two set-screws or pin it.

The heating box R (Fig. 159) is a cast-iron box, $9\frac{3}{4}$ in. by 2 in. by 2 in., into which are placed two removable iron blocks, each $3\frac{3}{4}$ in. by 1 in. by 1 in. This box is fastened by projecting arms between

the casting D, as indicated by dotted lines in Fig. 158. It is held in position by a stud at G (Figs. 158 and 159), and can be raised or lowered by the lifter S (Fig. 159), a ledge being made on the casting for this purpose.

When the heating box is raised, the material being kilted can easily be removed or replaced; but when the box is lowered it presses on the

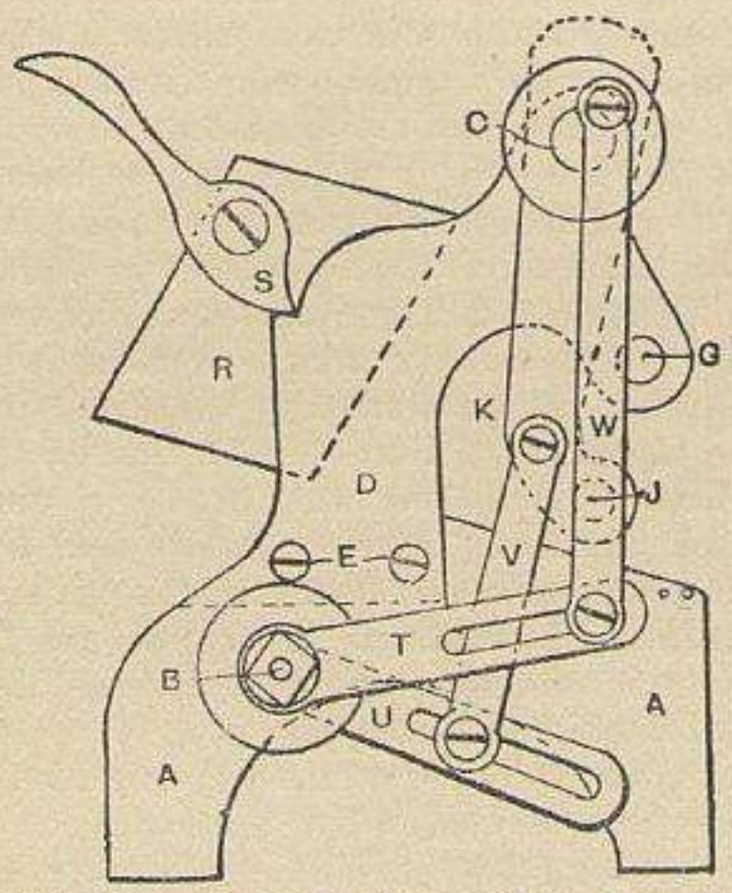


Fig. 159.—Side Elevation of Kilting Machine.

material, and the weight and heat combined has the same effect as ironing, causing the kilts to remain in position. In addition, the base of the machine is heated by gas, a Bunsen burner being fitted under the base. When this is alight a regular heat can be maintained. A rubber tube is used to connect with the main gas piping.

The lever T (Fig. 159) is a malleable casting having a boss, $1\frac{3}{4}$ in. in diameter, at one end. Measuring from the centre of the boss, it is about

4 in. long and $\frac{3}{4}$ in. wide by $\frac{3}{8}$ in. thick. It has a slot, $\frac{3}{8}$ in. by 2 in. long, into which is fitted a sliding block, $\frac{1}{2}$ in. by $\frac{3}{8}$ in. by $\frac{3}{8}$ in. The hole in the centre of the boss is $\frac{3}{8}$ in. in diameter. The lever U is similar to T, but it is $3\frac{1}{2}$ in. long. Both these levers are fitted to a $\frac{3}{8}$-in. spindle, which is threaded $\frac{5}{16}$ in. at one end and has a head, $\frac{9}{16}$ in. by $\frac{1}{8}$ in., at the other end. When fastening these levers, place a piece of butt leather, about $\frac{1}{8}$ in. thick, between the two bosses, add a washer and $\frac{5}{16}$ in. nut, and screw the bosses together, having the short lever inclined downwards more than the long one. These two levers move together, not independently; there are two levers only for the purpose of independent adjustment. The short link V is $3\frac{5}{8}$ in. by $\frac{3}{4}$ in. by $\frac{1}{4}$ in., and has two $\frac{3}{8}$-in holes drilled $3\frac{1}{8}$ in. from centre to centre.

The long link W is 5 in. by $\frac{3}{4}$ in. by $\frac{1}{4}$ in., and has two $\frac{3}{8}$-in. holes drilled $4\frac{3}{8}$ in. from centre to centre. These links are connected by pins and nuts, which must be fitted to allow the links to have perfect freedom. The rods X (Fig. 158), between which the material is placed, put tension on the material as it passes into the machine.

To operate the kilting machine, first heat the iron blocks and place them in the heating box. Light the gas jets and allow the machine to become thoroughly heated; then raise the heating box by the lifter, and place the material between the rods under the kilting blades to the rear of the machine. Lower the heating box; this holds the material firm. Now turn the hand-wheel from the operator, and the material will be formed into kilts, which will be forced beneath the heating box and will then be passed out.

Should the kilts accumulate under the box instead of feeding through, raise the box and release the material. A little practice is necessary to accomplish good work, though there is nothing very difficult to learn. The action of

the machine is as follows: The hand-wheel being turned causes the driving cam to revolve; thus the link W moves levers T and U downwards, the short link V drawing the rocking frame with it. The kilting blades are forced on the material by the action of the eccentric on the presser spring, and the material is forced into a pleat or kilt and carried under the heating box. The pressure of this box holds the material whilst the rocking frame recedes; at the same time the pressure is released from the kilting blades by the motion of the presser eccentric. This particular part is timed on the shaft to act in this way. The width of the kilt can be altered by moving the stud screws along the slotted levers T and U (Fig. 159).

The kilting machine is not, strictly speaking, a sewing machine attachment, but it will be found of great use in the production of work in which machining can be regarded only as a useful aid.

CHAPTER VII.

TAILORS' HIGH-SPEED SEWING MACHINES.

HIGH-SPEED sewing machines used for tailoring and similar work should be very strongly built, and a well-made machine answering this requirement is shown by Fig. 160, this being a general view with the parts exposed. Fig. 161 shows an end section, and illustrates the shuttle mechanism, lettered differently.

The upper shaft has three bearings, which are self-lubricating, and the hand-wheel is so balanced that when the machine is working at great speed the vibration is reduced to a minimum.

The action of the shuttle (Fig. 162) is reciprocating, and is produced by a crank A (Fig. 160) in the upper shaft; this crank, by means of a connecting lever B, oscillates the rocking shaft C, which has a forked part transmitting the action to the shuttle carrier shaft D. The shuttle oscillates in a raceway, which is better seen in Fig. 161, and is constructed on the central bobbin principle. The time of the shuttle and the needle in these machines can usually be relied upon, though it is necessary sometimes to twist the needle slightly to the front or back to prevent miss-stitch.

As in all machines, if the shuttle becomes so worn as to allow much sideplay, and the stitch is therefore missed, remove the old shuttle and insert a new one, making sure that it is exactly the same size and shape as the original.

When fitting a new shuttle, examine the neck and two projecting prongs, and remove any rough places with fine emery cloth. If either prong becomes broken off, as is likely if the bobbin case

is not secured properly, a new shuttle must be fitted. Shuttles are sometimes blunt at the nose, and need to be carefully shaped up from the rear side until pointed; but a knife edge must be avoided, as this would cut the cotton. The

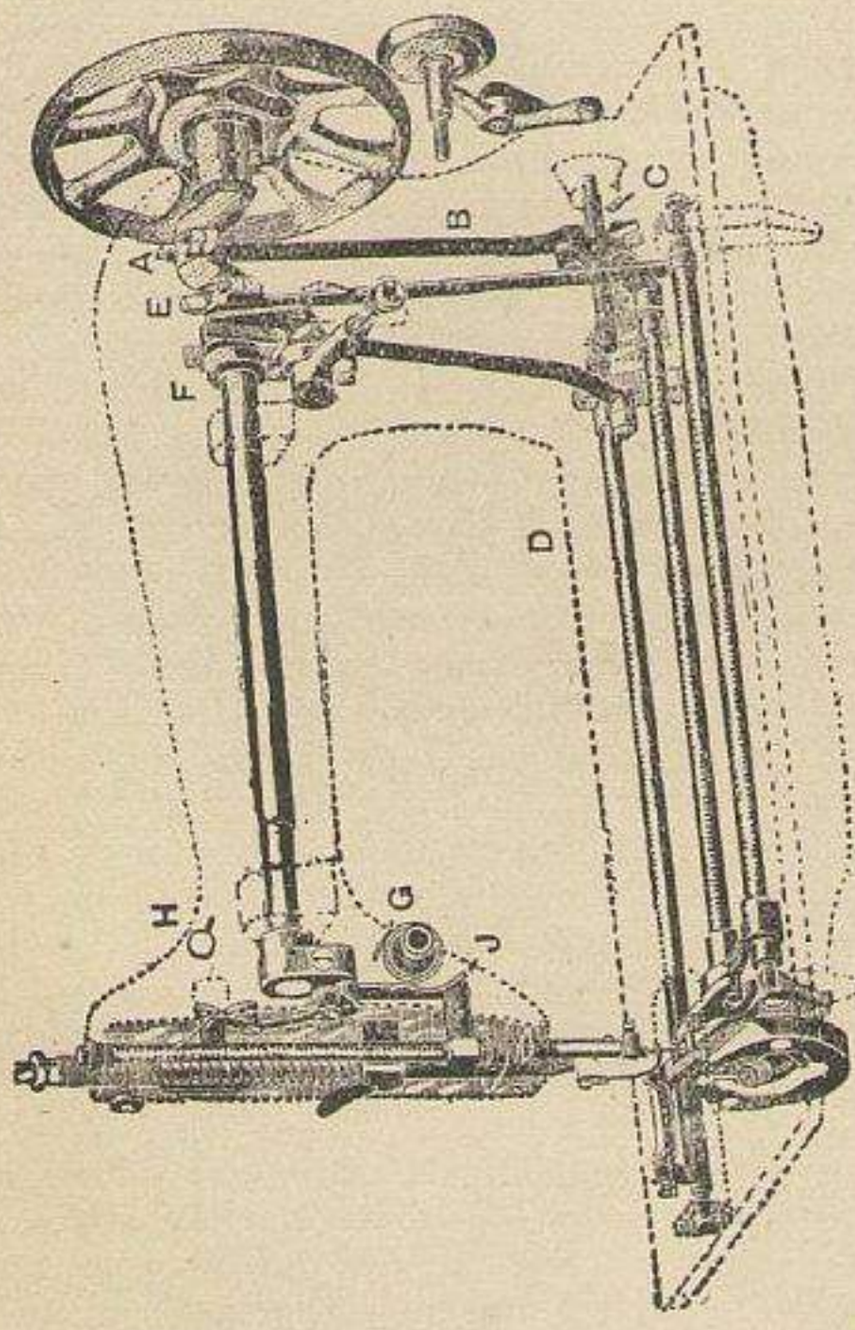


Fig. 160.—Tailor's High-speed Sewing Machine.

shuttle carrier must be kept perfectly smooth at each end, and should be in such a position that the needle will just clear it in its downward movement. If too much space is allowed between the carrier and needle, the shuttle is liable to strike

the needle and break it; but the carrier must not deflect the needle in any way.

Bobbin cases are made in two styles, one with

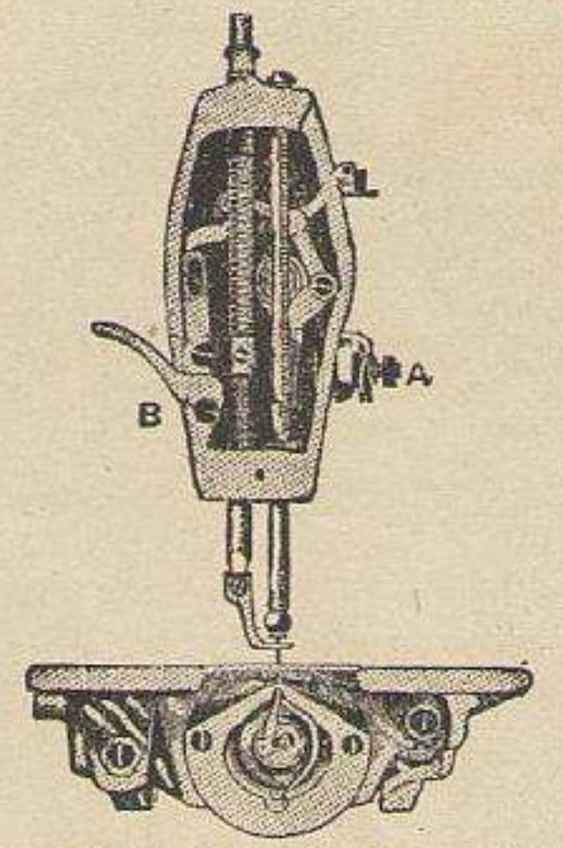


Fig. 161.—End Section of High-speed Machine.

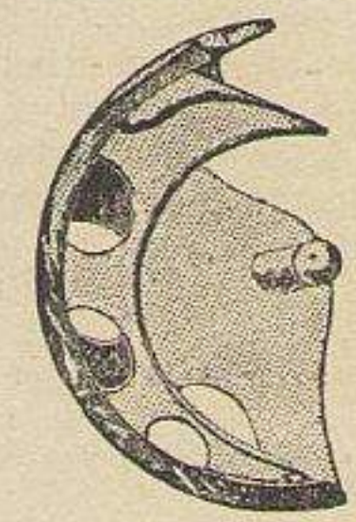


Fig. 162.—Shuttle.

a short stop, as in Figs. 163 and 164, the other with a long stop, as shown in the end section (Fig. 161). Raceways and bobbin cases must

correspond. The case should be placed in the raceway so that the stop will enter the recess, thus preventing it oscillating with the shuttle. The spring (Fig. 165) is used for producing tension

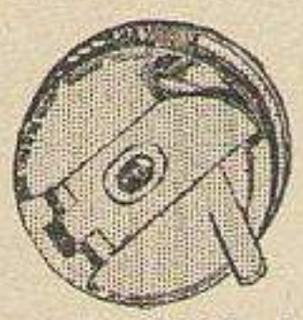


Fig. 163.—Bobbin Case, Showing Position of Short Stop.

Fig. 164.—Stop Ready for Riveting.

on the bobbin thread. If this spring is much worn, irregular tension will result, and a new one must be fitted, first removing the small screw. Sometimes springs require to be bent slightly before the required tension is obtained.

Fig. 165.—Tension Spring.

Care should be exercised when turning in the tension screw, for when screwed in too far the tension spring will press against the end of the slide (Fig. 166), causing it to release the hinge,

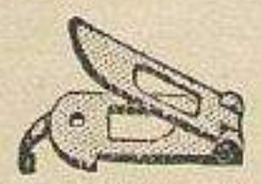
Fig. 166. 

Fig. 167.

Figs. 166 and 167.—Slide and Spring for Holding Bobbin Case to Stud.

which may trap the cotton as it passes over the shuttle.

The bobbin case is placed upon a grooved stud in the centre of the shuttle, and is held on this

stud with a hinged slide and spring (Figs. 166 and 167). To take out an old hinge or spring, first remove the tension spring, then take out the small screw from the under side of the hinge-slide (the head of which is seen inside the case), when

Fig. 168.—Steel Cap for Shuttle Raceway.

it can be easily withdrawn. In replacing, test the new hinge-slide to make sure it moves quite easily, as any sluggishness might prevent it gripping the shuttle stud securely, which might result in damage being done to the shuttle. The stop, which is shown in Fig. 164 ready for riveting to the bobbin case, frequently becomes loosened, and causes the upper cotton to break. After riveting, therefore, it should be soldered, and all sharp or rough places removed.

The feed is positive, the action being obtained from two cams on the upper shaft. E (Fig. 160) gives the rise and fall to the feeder, whilst F produces the length of stitch. Any looseness in the forked connection or upon any shaft centre-screw must be avoided, to preserve regularity and uniformity of stitch. The teeth of the feed should be kept sharp.

Fig. 168 illustrates a thin steel cap which is screwed to the top of the shuttle raceway to prevent the loop being carried by the shuttle into the

Fig. 169.—Spindle of Shuttle Rock Shaft.

race, which would cause the cotton to break. The constant friction of the cotton on this thin part will be found to wear two nicks in it. When adjusting a machine or fitting a new shuttle, remove these worn places by rubbing very carefully with emery

cloth; but if the nicks are very deep, it is better to fit a new part.

The hollow spindle (Fig. 169) on which oscillates the shuttle rock shaft C (Fig. 160) can be taken out by loosening a small set-screw found on the under side of the casting and drawing it to the right hand. The spindle has several small holes in it for the purpose of distributing oil over the entire length of the rock shaft, which is very essential

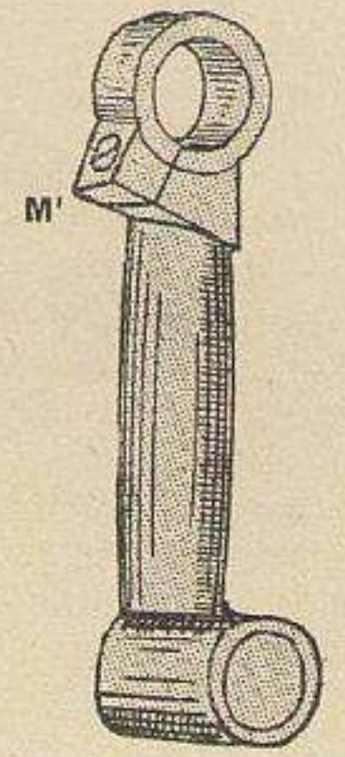


Fig. 170.—Link for Driving Needle Bar

when a machine is worked at a high rate of speed. When replacing this part, press it in as far as it will go, so that the set-screw will bear against the flat indicated by L.

The needle-bar in this class of machine is driven by a link (Fig. 170). Should this become loose upon its stud, tighten the adjusting screw M, but on no account allow it to bind on the stud. Should the link become bent, do not attempt to straighten it, as it is better to fit a new one.

The take-up lever (Fig. 171) is controlled not by a cam, but by links and studs (see Fig. 161),

and is known as the link take-up. This method produces positive action, and enables the machine to be worked at a higher speed, without noise, than when driven by a cam. If kept thoroughly oiled, the lever will seldom need further attention.

The take-up spring is located at the back of the tension, which is on the front of the arm A (Fig. 161). Sufficient pressure should be put upon this spring to ensure its falling positively on the stop, which is formed by the projecting edge of an iron bushing containing the take-up spring. Too much

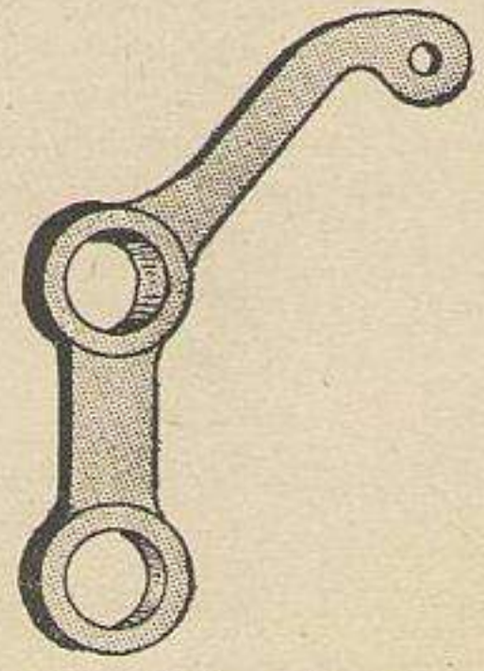


Fig. 171.—Take-up Lever.

pressure on this spring will make it difficult to regulate the upper tension, especially on thin materials such as cambric or silk. It should be regulated according to the size of thread in use and the material to be stitched. Coarse threads and heavy goods need more pressure than fine ones, this pressure being regulated by the position in which the spring is held by the tension post. To put more pressure on the spring, loosen the tension post by means of a small screwdriver, then turn the spring round a little to the right hand and retighten the tension post; to reduce

the pressure, reverse the process. To give more action to the spring, loosen the bushing set-screw G (Fig. 160), and with a screwdriver turn the tension post A (Fig. 161) to the right hand (this turns the bushing as well); afterwards tighten the set-screw G (Fig. 160); reverse the operation if less action is required.

When working a common grade of cotton on these machines at high speed, it is advisable to allow the take-up spring to act until the needle-bar has reached its lowest point of travel; more action after this has a tendency to cause miss-stitch, while less action may allow the cotton to become entangled in the shuttle race and break, or it may lie in little loops and knots on the under side of the material. Figs. 172 to 174 show the

Fig. 172. Fig. 173. Fig. 174.

Figs. 172–174.—Cotton Guides.

guides over which the cotton has to pass; these must be kept perfectly smooth, as any nicks will chafe the cotton.

Any alterations to the height or position of the presser foot can be made by loosening the set-screw B (Fig. 161). For instance, suppose there is not room enough between the needle-plate and foot to allow for very thick work. First raise the presser foot by means of lifter C (Fig. 161), then remove the face-plate, loosen the set-screw B, raise the presser bar to the required height, and tighten the set-screw firmly. Be sure to set it so that the needle will descend in the centre of the hole in the foot. It should not be set so high as to allow the needle-bar to bear against it when it descends to the lowest point of travel. Any roughness about the hole in the foot should be

removed. Set the needle as high as it will go, and with its short groove to the right hand—that is, facing the shuttle.

To thread the machine, place the cotton on the spool-pin, thence to thread-check H (Fig. 160), which should very slightly nip the cotton; then between the tension discs from right to left into the take-up spring, under the tread-guide bar J, up and through the hole in the take-up lever from right to left; then into the two guides on face-plate (Figs. 172 and 174), into needle-bar thread-guide (Fig. 173), and through the needle-eye from left to right.

To thread the bobbin case, hold the case in the left hand with the open part towards the operator; place in the bobbin and draw the cotton into the slot and under the tension spring.

CHAPTER VIII.

POWER-DRIVEN SEWING MACHINES.

WHEN a large number of sewing machines is employed in one establishment regularly for many hours every day it is often necessary to relieve the operators of the arduous work of treadling and to drive the machines by power. This means a higher rate of speed, more careful work on the part of the operators, who, of course, do not tire so soon as when they have to drive as well as manage the machines, and consequent economy. The following information will be of service to those seeking a good and cheap method of applying power to sewing machines that are at present worked by foot-power.

Fig. 175 represents one of the many forms of benches used when working sewing machines by steam, gas, or electricity. The bench consists chiefly of iron standards A, placed 3 ft. apart and fastened to the floor by wood or coach screws. A wooden top B, usually made of pitchpine, 1 ft. 1 in. by $1\frac{1}{4}$ in., is secured to the standards with $1\frac{1}{4}$-in. wood screws. Three-feet wood sections are sometimes used instead of the pitch-pine planks. These sections are prepared ready for use, and can easily be taken off or put on, thus saving much time where changing of machines is necessary.

Benches are classified as single and double, and may be built flat top or trough as desired. Fig. 176 shows the end view of a double trough bench. As will be seen, the iron standards have arms or extensions shaped to receive the wooden trough, which may be made from $\frac{3}{4}$-in. match-boarding.

In a flat-top bench the iron standards have arms or extensions, as indicated in Fig. 175, upon which is laid the ¾-in. matchboarding, and it is held rigid by ⅝-in. wood screws, which are inserted through holes in the iron extensions. Holes are cut in the bench top to receive the machine heads, which are usually set 3 ft. from needle to needle, but may be set further apart if more space is required for the goods. On the floor are fixed a number of shaft pedestals C (Fig. 175); these are 1¼-in. bore and about 8½ in. high (that is, from the floor to the centre of the bore). They are fixed

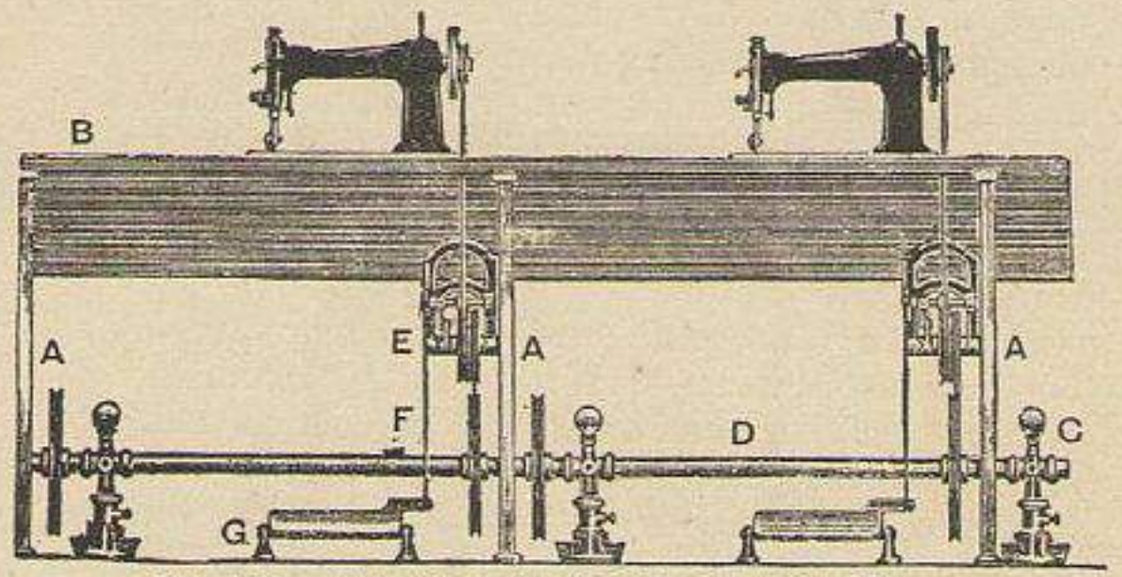


Fig. 175.—Working Sewing Machines by Power.

from 3 ft. to 4 ft. apart and so that the shaft D (Fig. 175) will be in the centre and run parallel with the bench (see Fig. 176). The speed of this shaft should be about 300 revolutions a minute, and it receives its motion from an engine or another shaft (generally a counter-shaft) by means of a flat belt driving on to a pair of fast and loose pulleys. It can be instantly started or stopped by a belt-shifter or striking gear.

The machines are worked from a transmitter E (Fig. 175), which is either attached to the iron standard or is screwed to the under side of the bench. It has one pulley, which is held tight by

a wood or leather brake; also a loose pulley (or maybe a series of loose pulleys of different sizes). The wire rod F connects the transmitter lever to the treadle G, which is fastened to the floor by 1-in. wood screws. The transmitter should be so fixed that the fast pulley is in direct line with the groove of the hand wheel on the machine head. Two holes must be bored through the bench with a ¾-in. bit; then fasten a belt round the fast pulley of the transmitter, through the holes in the bench on to the hand wheel of the machine.

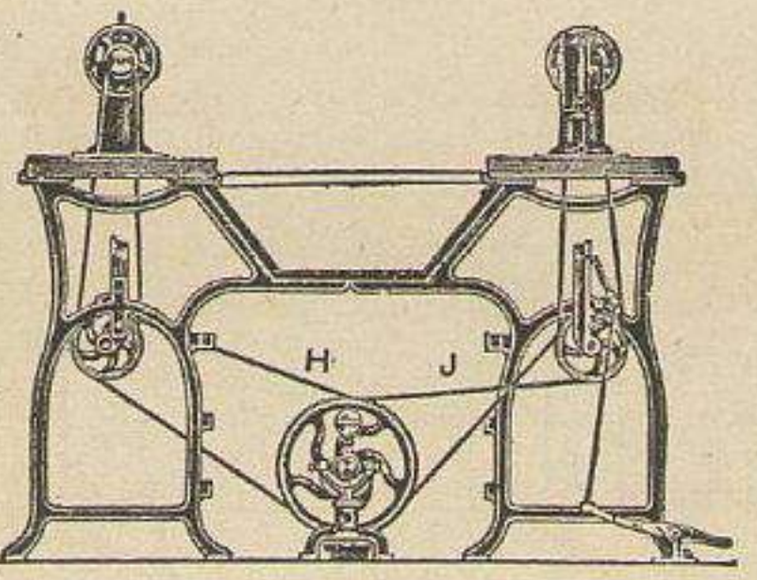


Fig. 176.—End View of Double Trough Bench.

The belt should be just tight enough to drive the machine, and not so tight as to cause any extra strain. Fix a grooved pulley (size according to speed required) on the shaft in exact line with the groove of the loose pulley on the transmitter, and connect these two pulleys with a belt, which may be straight or crossed according to the direction the machine wheel has to revolve; see H and J (Fig. 176).

To set the machine in motion, press down the back of the treadle with the foot. This causes the wire rod F (Fig. 175) to lift the brake lever and release the tight pulley, and at the same time

makes the two pulleys press together firmly and turn at a high speed; this, by means of the upper belt, sets the machine in motion. The speed is regulated by the pressure put on the treadle.

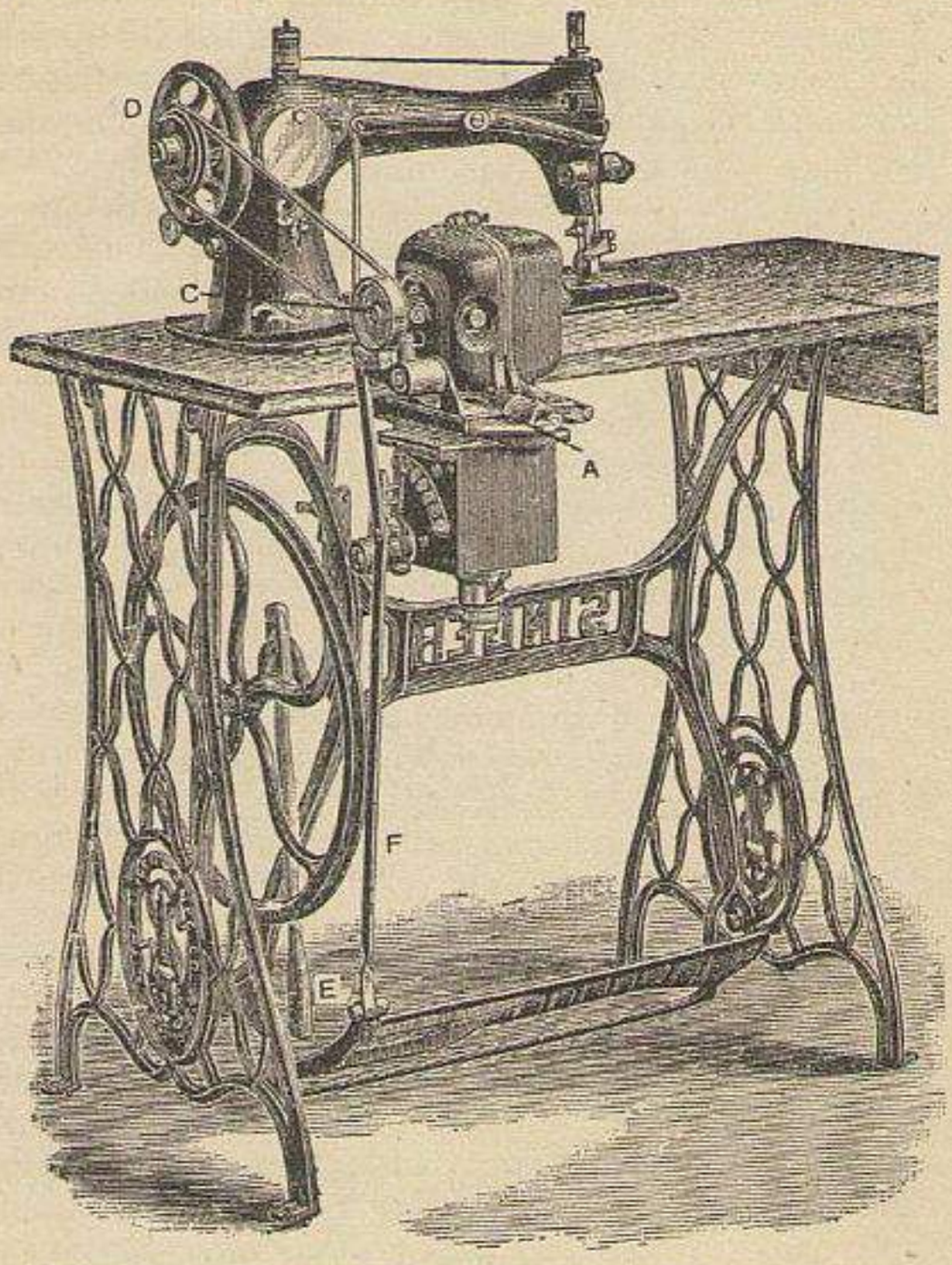


Fig. 177.—Driving Sewing Machine by Electric Motor.

The machine may be started or stopped instantly by pressing or releasing the treadle. One machine might be worked by fixing a small motor on the floor at the rear of the machine, and

driving direct from the motor to the transmitter, and from the transmitter to the machine. A transmitter is necessary in order to start and stop at will.

The two extra groove pulleys in Fig. 175 are for the machine on the opposite side of the bench, showing that the needles are almost directly opposite each other. Thus sometimes one gas-light is used for two machines.

One of the latest methods of operating a sewing machine by electric power is illustrated by Fig. 177. It is the method adopted by the Singer company. The motor A is fixed to the machine table in such a position that the groove of the motor driving pulley C is in direct line with the hand-wheel D of the machine. A band about ¼ in. in diameter connects the two for driving purposes. To use the motor, the lower end of the stand wheel pitman or wooden connection E is disconnected from the treadle, whilst a long rod F is substituted, and forms both a pitman and a brake lever. Various speeds may be obtained by pressing the treadle downwards with one foot. By removing the foot pressure from the treadle, the current is automatically cut off and the brake applied, thus stopping the machine instantly. The Singer Manufacturing Company supply motors for this purpose from $\frac{1}{10}$ horse-power upwards.

It must be understood that the information and illustrations given in this chapter refer to but a selection of the means possible of adoption for driving sewing machines by power. Most manufacturers have a special system of their own, and it is now becoming usual for domestic sewing machines to be fitted with small electric motors, which can be operated with practically no trouble whatever. The Singer system illustrated by Fig. 177 is a case in point. The Bradbury is also a good arrangement. In general appearance it does not differ from an ordinary machine with treadle,

and it can be driven by the feet of the operator when it is not convenient to drive the machine by motor. Both motor and switch are attached to the underside of the machine table, the motor being of the Aston-Lundell type, and made in England. The operator controls the motor with his feet, thus leaving his hands free to manipulate the material. A slight movement of the feet on the foot-plate is communicated by a wooden rod to the switch secured to the underside of the table. In a modification of this arrangement the switch is fitted on the top of the table by the side of the driving wheel. The operator's right hand then controls the machine, and there is no connection to a foot-plate. The switch lever performs two functions. In the first case, it starts, regulates, and stops the motor and machine; and in the second place, it applies a brake to the driving wheel for bringing the machine to rest instantly, should this become necessary. The kind of motor fitted to the machine will depend upon the kind of electric current available for use, and before ordering such a machine, great care should be taken to get from a reliable source correct particulars of the current, so that the motor fitted may be of the right kind.

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